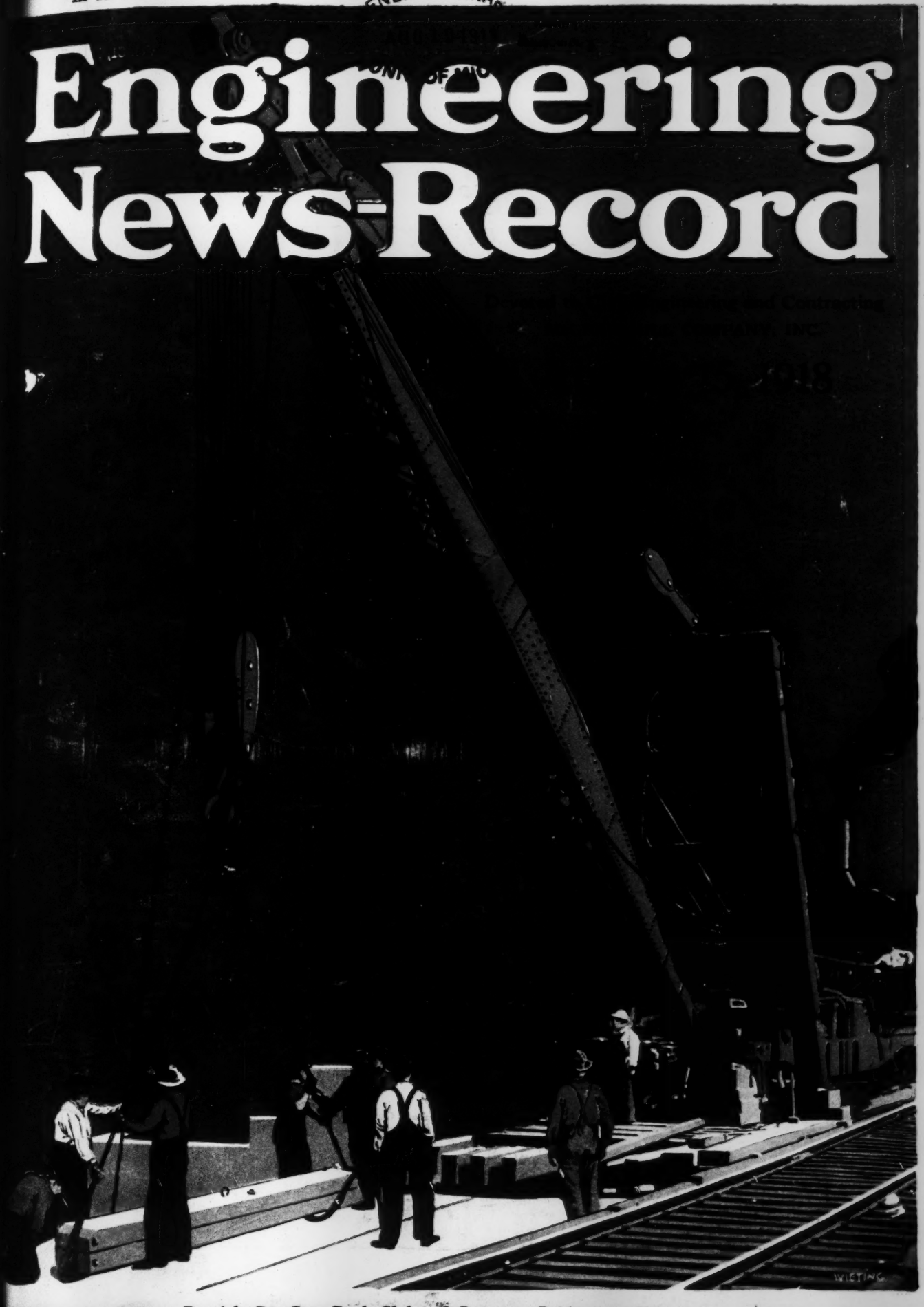
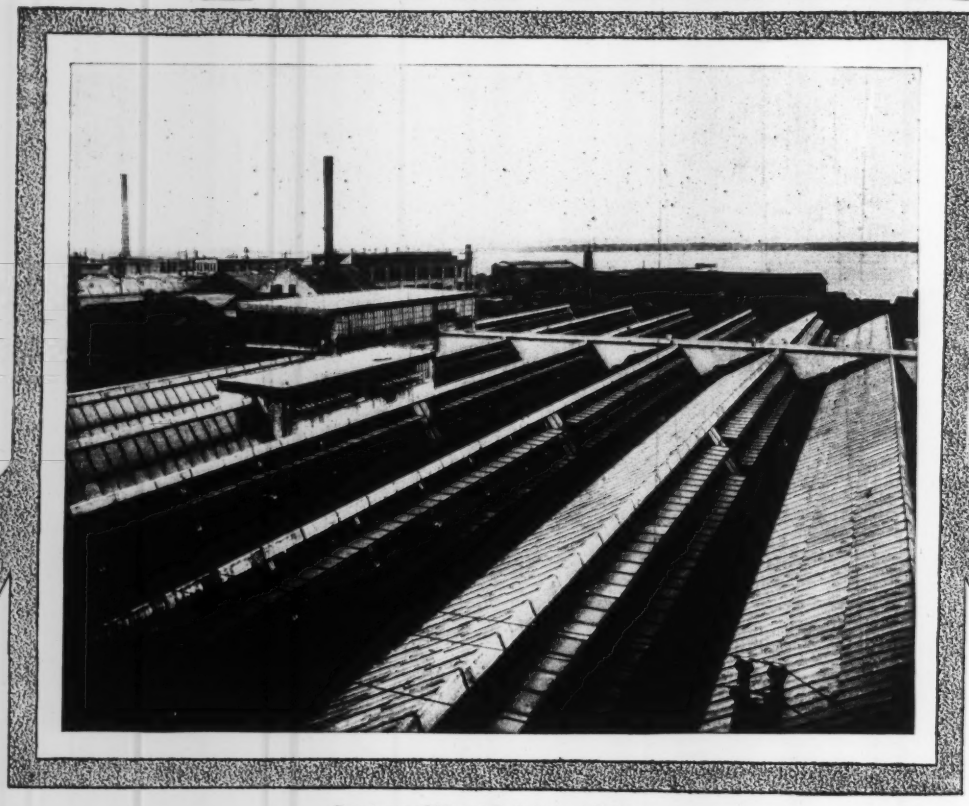
In This Issue—Contractor Clips Six Weeks From Construction Time on Chicago Army Base.

Engineering News-Record



Derrick Car Sets Deck Slabs of Concrete Bridges at Chicago.

Build for Permanence



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Volume 81 August 15, 1918 *Number 7*

Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD, WITH WHICH IS INCORPORATED THE CONTRACTOR.

E. J. MEHREN, *Editor*

CHARLES WHITING BAKER, *Consulting Editor*

Coördination Saves Six Weeks' Construction Time on Big Building 300

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 81 — NEW YORK, THURSDAY, AUGUST 15, 1918 — Number 7

Camp Sewage-Works Ordered Enlarged

PROMPT relief from the nuisance caused by overworked sewage disposal plants at army camps will follow the decision announced on page 336. It was not expected that such conditions as those at Camp Dix, New Jersey, commented on in our issue of Aug. 1, p. 206, would long continue. In fact, they would never have arisen had not the number of troops at the various camps been suddenly increased to send overseas a quarter million of men a month.

New England Water-Works Men to Meet in September

COMMENDATION is due the New England Water-Works Association for revising its announced decision not to hold its usual fall convention and deciding to gather in Boston Sept. 11-12 for a strictly business meeting devoted chiefly to war-time problems. Such a plan is outlined on p. 329 in a letter from C. E. Davis, which mentions other commendable work by the association to meet the needs of this critical time. This journal has maintained that technical associations whose existence can be justified should not abandon their conventions in these strenuous times. Water-works men have many war problems to solve, as the report of the War Burdens Committee of the American Water-Works Association, abstracted on p. 308 and commented on in another editorial, bears witness. The New England association might well join in the work so well begun by its sister organization.

New Orleans' New Harbor Unique in Many Ways

NEW ORLEANS and the State of Louisiana are to be congratulated. In these days, when no city or state undertakes an improvement without first trying to persuade someone in Washington that it is a Federal necessity and consequently deserving of some of the thirty billions of Government war appropriations, it is refreshing to find one community ready to initiate and finance its own development, asking of the Government only permission to float its bonds. But the New Orleans' inner harbor and navigation canal, described in this issue, is more than an example of local enterprise. It is a contribution to harbor design unique in this country, if not in the world. European ports with their wide ranges of tide have inland harbors where constant level is preserved by a lock entrance, and in the United States the Lake Washington canal and lock at Seattle opens up an inland lake to ocean traffic. In these cases the canal or lock is merely a connecting link to the main basin where the docks and warehouses are located. At New Orleans the canal is itself a harbor, with its own wharves and industrial sites, as well as a passageway to a fixed level body of water which may itself some day be developed as a harbor. Furthermore, the construction has novelty as well as the design and financing. Building ships literally in a city street and digging the waterway a mile or so up to the shipyard in time to launch them is war emergency construction with a vengeance.

If Our Meteorological Records Were Extended

SPECULATION on what meteorological extremes would be shown if systematic records went back a few hundred or a thousand years instead of a half century is revived by the intense heat which hung over a large part of the country last week. To take only one city, the record breaking maximum of 102° at New York City on Aug. 7 makes all the deeper impression in contrast with the broken record at the other extreme only eight months ago when the mercury fell to —13°, giving a range of 115° within less than a year. The record at New York is for 47 years. The nearest approach to the 102° of last week within the record was 100° in early September, 1881, or 37 years ago. Continuous rainfall records kept at a few American cities for 75 to 100 years, presented and discussed in *Engineering News* of Nov. 19, 1914, and later, only increase the wonderment as to what our meteorological extremes would be if the records covered thousands instead of scores of years, hundreds or thousands of localities, and the highest altitudes, instead of being restricted so generally to sea level or other relatively low-lying places. Improved as is our Weather Bureau Service over earlier years, the country at large has great need for many more well-equipped observation stations, particularly in the West and at higher altitudes.

A Bullet In the Head

HE HAD lately returned from France, after three and a half years with the British Army—in the fateful fighting of Ypres, in the Somme offensive, in the holding of the lines in northern France. He was observing with the most intense interest the play of the new forces of labor, the evidences of discontent and the sure indication of a future effort of those with force but not ability to usurp the places of those who have managed large and difficult affairs. He talked rather doubtfully about a future that may be filled with

much experimenting by those newly come to power. "What a lesson we can learn," said he, "from the battle line! There every man must do the part for which he is best fitted. The keenest of hearing go into the listening posts. The alert do patrol duty. Those who thrive on excitement man the machine guns. The natural leaders among the infantry officers remain, while those wrongly placed are sent back to the non-fighting bases. The penalty for blundering, for putting the wrong men in a given place, is death—death for the individual if the wrong man be a private, death possibly for a whole company if he be a commander. That is a big lesson of the trenches—each must do that for which he is best fitted. Otherwise, a bullet in the head is the punishment." He did not urge contentment. He did not appeal to patriotism. His was an argument for service—to do the maximum one's powers permits, but not to clog the wheels of life by vain strivings in positions where others can render the better service.

Unwarranted Accident Waste in Construction

CONSTRUCTION lags far behind the manufacturing industries in accident prevention. It is high time that the progress be accelerated. Neglecting entirely the humanitarian factor, construction is paying too high a price for its tardiness. Insurance of construction workers costs considerably more than insurance of factory operatives. Employees-accident compensation laws are taking away from the contractor any chance he formerly possessed of adjusting damage fees by compromise or court action. Construction can no longer escape the penalty of carelessness, and must decrease the accident rate or pay the price for neglect.

Statistics are not complete, but they are sufficiently plentiful to prove construction extra hazardous compared with almost any other industrial employment. The New York Industrial Commission states that more men are killed in construction work than in all the factories of the state, although factory workers are four times as numerous as construction workers. In Wisconsin construction labor is only 5 per cent. of the total number of workers, yet their occupation contributes from 15 to 20 per cent. of the fatal and serious injuries. The Pennsylvania building trades alone, during the first six months of this year, showed an accident record of 111 persons killed and 1600 injured sufficiently to receive compensation. Notice the proportion of deaths. Casualties on the battle front in France exhibit hardly a worse record of fatalities. Certainly no other industry presents such a record.

It is impossible to estimate the cost to the construction business of this needless hazard. This cost certainly is not limited to the damage fees paid. Accidents interrupt the progress of work; they deplete the working force and injure its morale; they frequently involve damage to plant and structure. These indirect results of accident may easily exceed in cost the compensation to injured workmen. And most of this waste is preventable, as the experience of the Fred T. Ley Co., outlined in the *Engineering News-Record* of March 14, 1918, page 523, clearly demonstrates. These contractors, in their second year of systematic effort to reduce accidents, decreased their frequency 55 per cent. and their cost 66 per cent. Any contractor can do as well. It is time for the construction business to set its house in order in the matter of accident prevention. The precedent has been established. The fact has been demonstrated that accident prevention is good business. And it is equally evident, from the statistics quoted, that the lesson of the Ley's experience has made little impression on other contractors.

A means for exchanging experience and securing the benefit of organization is to be afforded by the National Safety Council, which at its congress in St. Louis next month will organize a Construction Section and devote a goodly share of its program to papers and discussion on accident prevention in construction work. Participation by contractors in the activities of this congress will greatly strengthen the new section which can initiate, through coöperation, a movement of the highest value to the construction business. Without a doubt such a body as the proposed national organization of general contractors can also coöperate very effectively in such a movement. Certainly the present fact that construction is the most backward of all industries in such a vital matter as accident prevention is not a credit to the intelligence enlisted in this field.

A Moses for the Highways

RECENTLY Edward N. Hurley, chairman of the Shipping Board, has sent to civic and commercial organizations an eloquent plea for the formation by them of committees on merchant marine. He points out that the lack of interest in shipping by the public caused the decay of the merchant marine of the early nineteenth century, and he proposes that our new-found fleet shall not go the way of its predecessor.

Mr. Hurley should be supported. He is dealing intelligently with one of the problems of reconstruction. He is also dealing with transportation—ocean transportation—the top rung of the transportation ladder.

We wish that a Hurley or a Schwab would be the appointed champion of the first rung of the transportation ladder—the highways. They are a football in Weshington, their care being entrusted to a subordinate branch of a great administrative department. Schwab and Hurley stand for ocean transportation, a Railroad Administration takes care of the rails; highways, after a long struggle, in which they have been kicked and cuffed by the fuel, railroad and financial administrations, are championed by a Highways Council that not only has its acts nullified by the Capital Issues Committee, but is professedly a sorting out and discriminating body. On the one hand, ocean and rail transportation are championed by promotors, by those who possess a large vision and are telling it to the country. On the other, highways are subjected to the scrutiny of a board, not intent on promoting maximum use of a war essential, but rather upon its curtailment to the point where the curtailment will not hurt. The one is a progressive, positive attitude; the other a backward, negative one. Expansion is the one keynote; contraction the other.

We need someone in Washington who sees the true relation of the highways to the winning of the war, who will stand for promotion, who will point the visions, who will not let our Government be blind to

England's war experience with her roads. We need a Moses, and we need him at once. In fact, his coming has been six months delayed.

Co-ordinating Construction Work

EXCELLENCE of construction management can be measured broadly by the degree of coördination of operations. That good management prevailed on the Chicago quartermaster's depot work is, therefore, the first conclusion which one draws from the story in this issue. It is, however, the conclusion of least significance.

Coördination of plant units and of working gangs is nothing new in construction. Every manager who is worth his salt secures coördination. He does it unconsciously. Perhaps it has not been developed with him in most cases to the permanency of a doctrine. When it is so developed, his every effort and action toward coördination is conscious.

Coördination at the Chicago quartermaster's depot was the result of conscious action. The ways adopted deserve attention. Outstanding is the fact that all of them were taken consciously.

Evidence of the economic value of coördinating construction operation furnished by the Chicago work being considered is that it has been the chief instrument in clipping a week a month from a construction schedule set in the first place at a rather high rate.

War Burdens of Water-Works

INCREASED construction and operation costs of water-works in the short period since 1915 is strikingly shown by the War Burdens Committee report to the American Water-Works Association, presented in part in this issue.

Labor costs, or rather the rate of wages paid to labor, have not gone up to any such degree as the costs of materials, but the belief is general that the efficiency of labor is much less than it was three years ago. This is a serious matter—all the more so because the scarcity and inefficiency of labor is more likely to increase than to decrease in the next year or two, just as wages seem bound to rise. Probably the wage increase would be still larger, at least in the case of municipal works, if many cities were not hampered by ordinance or otherwise in raising wages. Possibly complaints of decreased labor efficiency would be less numerous and strong if the wage increase had been larger. This phase of the subject is not considered by the committee.

In fact, the committee has presented a considerable body of data and pointed out the upward trend of prices, but has not blocked out a plan to cope with the problem of increasing war burdens. Perhaps the Executive Committee of the Association will request the War Burdens Committee to carry its good work further into the field of constructive suggestion.

Portions of the report omitted from the abstract because of space considerations dwell upon the bearing of increased costs on rate fixing by state utility commissions. This is a serious matter for privately owned works and their patrons. Some of its aspects were discussed editorially in this journal Aug. 8, p. 255.

It should be remembered that in the water-works field municipal rather than private ownership prevails. This is true not only in the number of works but also and far more markedly in population supplied. Should the work of the committee be continued this fact should be taken into account. True, the municipally owned works have general taxation to fall back on. This makes it easier to let the matter of rate readjustments go by default for a time, but sooner or later there must come a reckoning.

Both privately and publicly owned water-works should give prompt and careful heed to the committee's plea for adequate records to show just how and why the war burdens of the water-works of the country are increasing. Indisputably our water-works are essential industries. Nothing in the municipal or utility field is more vital. It is imperative that they be maintained at a high state of efficiency. With the increased costs shown by the committee's report continued efficiency is impossible under pre-war rates—unless, indeed, those rates were too high, or unless the added burdens are to be shifted from the water consumers. Whether and to what extent stockholders or taxpayers should shoulder these burdens is a question which must be considered in each case in the light of local conditions. If the regulation in the past has allowed only a fair return, clearly the water users should bear the burden.

In any event the efficiency of our water-works must be maintained, with the most even-handed justice possible to the owners of the works on the one hand, and the consumers of water on the other. The more the subject is considered the more evident it becomes that the American Water-Works Association has made only a good beginning thus far in its bounden duty to the water-works fraternity and to the public.

State Your Case Plainly and Briefly

IF THE multitude of men who visit Washington or write to the Federal departments to obtain priorities will base their claims on the same kind of arguments that would be influential with themselves were they sitting in the seats of power, they will be very wise. Every agency in charge of permits is flooded with elaborate arguments in which the little kernel of sound sense is enveloped in such a thick husk of balderdash that the men charged with keeping the wheels of industry and commerce moving in harmony with the great military procession of events are hard pressed at times to find any real reasoning in these appeals. Altogether too many of these arguments resemble the pleas of a criminal lawyer defending a felon known to be guilty but having a chance of receiving a light sentence. The very form in which the request for Government action is often made diminishes the favor with which it is received. The Government is engaged in winning the war and that purpose is gradually absorbing a large part of the efforts of most of the Federal departments and agencies. Everything that is presented to a Government official is tested by the query: "Will this help win the war?" Applications for Government assistance should answer that question clearly, concisely and with absolute truth. This is no time for the verbal enthusiasm of selling arguments, and those who follow the methods of the unscrupulous salesman in their dealings with Washington diminish their chances of success, even with a good case.

Co-ordination Saves Six Weeks' Construction Time on Big Building

Duplicate Equipment Throughout Eliminates Plant Delays—Manual Operations Proceed on Time Table Schedule—Promoting Esprit de Corps Among Men Is Important Feature

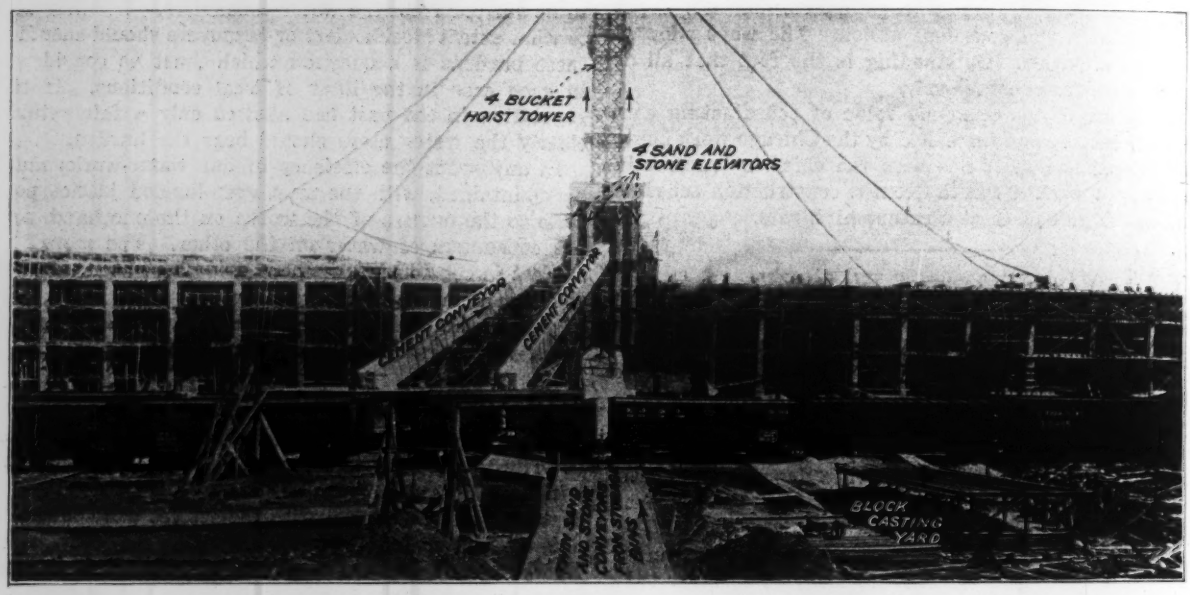
BY EXACT coördination of construction operations, high speed in placing concrete is being developed in constructing the new $3,000,000 quartermaster's depot at Chicago. With a special crew for each operation and all operations carried on in prescribed sequence, and by nearly automatic plant handling of materials, concrete has been put into forms at the rate of 1200 cu.yd. in five hours and a common day's run is 1650 to 1700 cu.yd. The result has been a gain in speed which promises to save six weeks' time on a job scheduled to require only six months for completion.

Quick handling and fabrication of large volumes of materials formed the construction problem. The Chicago quartermaster's depot is a six-story reinforced concrete frame and brick wall building covering, with court included, a ground area of 325 x 600 ft. The floor area is 1,250,000 sq.ft. or approximately 29 acres. Very massive construction is employed. The foundations are 611 concrete piers, 4 and 4½ ft. in diameter, sunk in open caissons to depths of from 23 to 27 ft. With their mushroomed bases the foundation piers contain 11,000 cu.yd. of concrete. Starting with a diameter of 36 in. at pier tops the column tiers decrease in diameter to 18 in. on the sixth story. Columns are spaced 18 ft. in both directions and carry 8-in. slabs reinforced for a live load of 300 lb. per square foot. Between wall columns the slabs for a width of 3 ft. are deepened to 13½ in., thus forming at each floor a shallow belt girder.

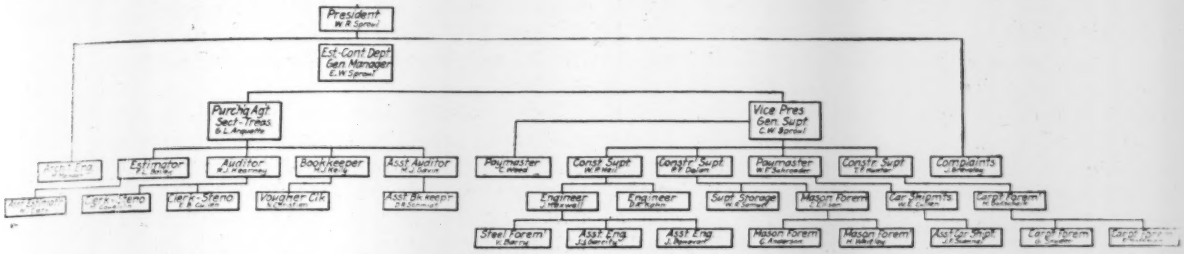
Summarized, concrete work quantities are: 62,000 cu.yd. of concrete; 3500 tons of reinforcing steel and 4,000,000 ft. b.m. of form lumber. These figures give 64½ ft. b.m. of lumber and 113 lb. of steel per cubic yard of concrete. In columns alone 5½ miles of spiral and vertical rods were used. The volumes of construction materials which had to be handled and fabricated become impressive when figured in these terms, but still more impressive when the speed factor is considered.

The construction time schedule as laid down at the beginning of work was: Excavation, 30 days; foundation piers, 30 days; concrete frame, 60 days; brick and terra cotta, 30 days; finishing the building, 45 days; a total of 195 days. The date for completion of the work was set at Oct. 15, 1918. Excavation was begun Mar. 6 and on June 30 the time schedule had been exceeded by 37 days. If the same rate of gain is maintained, the work will be completed by Sept. 1, or six weeks ahead of the date scheduled.

Organized coördination has been named as the means for the exceptional construction speed attained. This coördination began with a carefully drawn schedule of performance. Then the regular arrival of materials and supplies was planned. The plant was laid out in duplicate to prevent interruption from breakdowns, made as nearly as practicable automatic to reduce attendance, and coördinated unit to unit to a set nominal capacity. Plant and manual operations were then meshed closely with one another. Finally, the labor force was broken up into crews to secure the maximum



MATERIAL DELIVERY AND CONCRETE DISTRIBUTION CONTINUES MECHANICAL PROCESS FROM RAILWAY CARS TO RECEIVING HOPPERS ON BUILDING FLOORS



CONTRACTOR'S STAFF WHICH CLIPPED SIX WEEKS FROM SCHEDULE TIME OF SIX MONTHS

practicable subdivision of duties, and all crew operations were time tabled.

The main plant unit is that for mixing and distributing concrete. It was planned that all operations of this plant should be mechanical, from the first unloading of the material cars to the distribution of the mixed concrete to receiving hoppers on the building floors being concreted.

All materials come in on railway tracks parallel to the front of the building, as indicated by the plant layout diagrams. The building consists of two units separated, except for a narrow connecting structure, by a court 46½ ft. wide. At the entrance to this court, in front, is set a quadruple bucket hoist tower which delivers to four radial chutes. Twin mixers at the foot of the tower are charged by gravity from overhead bins set in a frame structure close in front of the tower. Sand and stone arriving on a track about 250 ft. back of the building are unloaded into a bin paralleling the track and are conveyed thence by a series of belt conveyors to elevator legs at the foot of the bin structure. Four elevators lift the sand and stone to the bins. Cement arriving by car on another parallel track nearer to the building is taken either from cars or from a storehouse to the bin elevation by inclined belt conveyors.

Delivery of materials to the mixer bins constitutes the first series of operations. The storage bins for sand and stone are 1000 ft. long and hold at each end three cars of sand and in the middle compartment eight cars of stone or gravel. They are 6 ft. deep. Cars on parallel tracks on either side are unloaded by locomotive cranes into the bins. In the bottom front of the bin, facing the building, are 52 slide gates which feed onto belt conveyors operating in a pit along the toe of the bin.

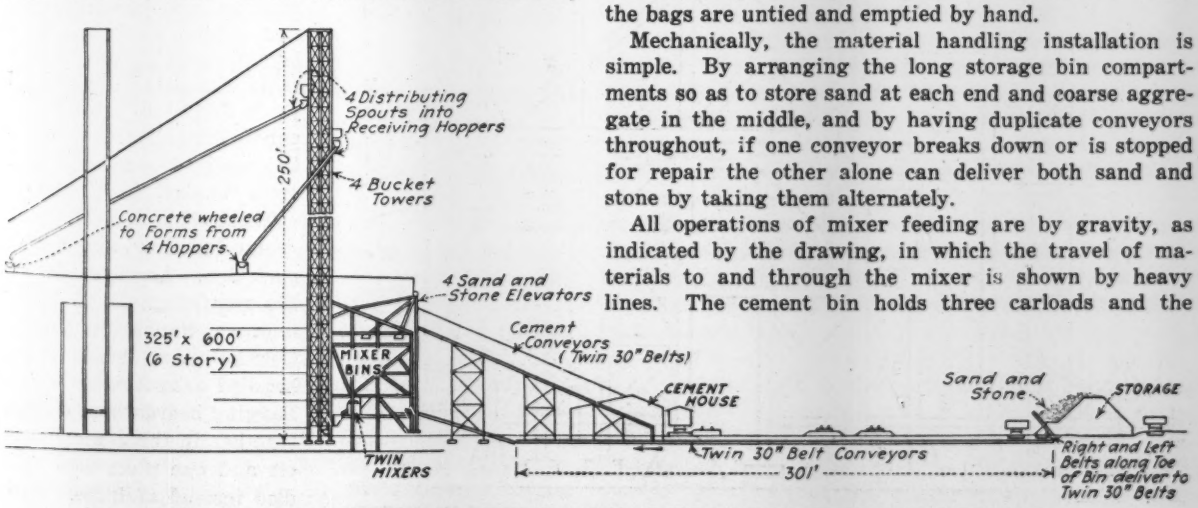
There are two conveyors, each 500 ft. with 24-in. belts. The belts travel in opposite directions toward the middle of the bin, casting their loads into a center hopper which delivers onto two 30-in. belts extending at right angles 301 ft. toward the mixer bins. These 30-in. belts run in a tunnel under the railway tracks and yards. At the end of the tunnel the material is fed onto twin inclined belts which run to the receiving bin located at the bottom of the bin structure, as shown by the large scale drawing. Four 15-hp. electric motors operate the belt conveyor system up to this point.

Four stands of elevators raise the sand and gravel to the elevated bins over the mixers. The receiving bin previously mentioned feeds by gates into troughs which are emptied by chain drags into the elevator boots. Each elevator is driven from the head by a 30-hp. electric motor. The chains carry 8 x 16-in. heavy pattern cups and each set discharges into a hoppered chute leading to the proper storage bin.

Cement delivery is a more simple operation than is the delivery of sand and stone. From the cement storehouse, having a capacity of three carloads, two 30-in. belt conveyors reach to the cement-handling floor over the elevator bins. At the bottom these conveyors are so arranged that the cement bags can be unloaded onto them directly from the cars or from the stacks in the cement house. At the top they discharge onto roller chutes ending on the grid top of the cement bin. There the bags are untied and emptied by hand.

Mechanically, the material handling installation is simple. By arranging the long storage bin compartments so as to store sand at each end and coarse aggregate in the middle, and by having duplicate conveyors throughout, if one conveyor breaks down or is stopped for repair the other alone can deliver both sand and stone by taking them alternately.

All operations of mixer feeding are by gravity, as indicated by the drawing, in which the travel of materials to and through the mixer is shown by heavy lines. The cement bin holds three carloads and the

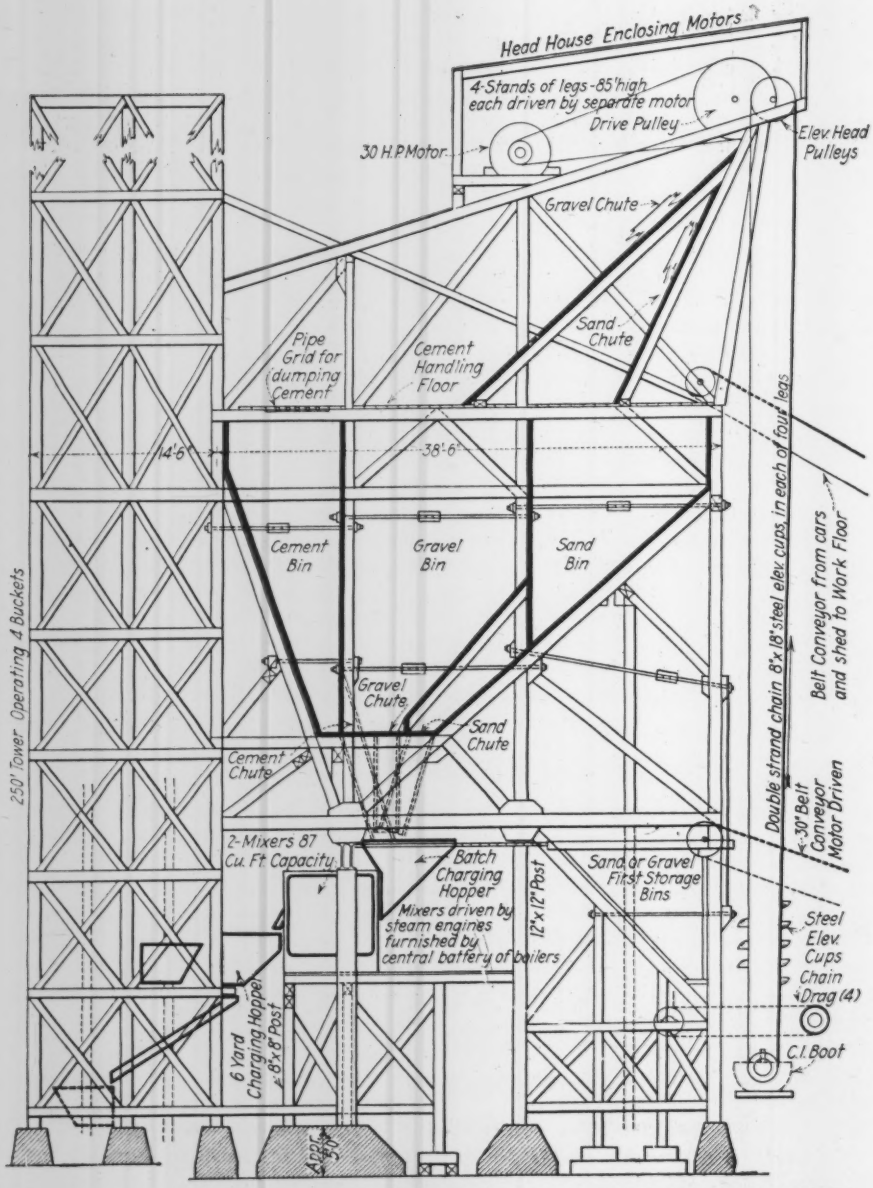

4 Distributing Spouts into Receiving Hoppers
4 Bucket Towers
250'
Concrete wheeled to Forms from 4 Hoppers
4 Sand and Stone Elevators
325' x 600' (6 Story)
MIXER BINS
Cement Conveyors (Twin 30" Belts)
CEMENT HOUSE
Sand and Stone
STORAGE
TWIN MIXERS
Twin 30" Belt Conveyors
301'
Right and Left Belts along Toe of Bin deliver to Twin 30" Belts

GRAVITY FEEDS MATERIALS FROM BINS THROUGH MIXERS TO TOWER BUCKETS

sand and stone bins have capacities respectively of 360 and 600 cu.yd. These amounts are sufficient for a half day's run of the mixers should there be a breakdown of the material conveying system. The batch charging hopper is located directly over the mixer and under the bins. Measuring chutes lead from the bins to the hopper, and as soon as one charge is withdrawn from the hopper into a mixer the hopper is filled again for the other mixer. There are two 56-cu.ft. mixers with a rated capacity of 85 cu.yd. per day. They discharge directly into the tower buckets. The mixers are the only steam-operated unit of the concreting plant; two 40-hp. boilers outside of the bin structure furnish the steam.

The distributing tower is 14½ ft. square and 250 ft. high. It accommodates four 2-cu.yd. buckets which are handled by electric hoists. Four distributing chutes terminate in receiving hoppers which are moved from place to place on the floor being concreted so as to keep the cart haul short. The longest run of any spout is 500 ft., and in no case so far has the cart haul exceeded 100 feet.

Plant coördination is manifested in the train of mechanism described in these obvious particulars. Machine attendance is reduced to the minimum by employing electric drives. This reduces the chances of any unit being undermanned by workmen laying off and thus cutting down the output of coördinate units. Duplicate units are provided of all moving mechanism so that a breakdown of one unit of a pair does not wholly stop the output. Indeed, each unit of a pair, by a little speeding up, can even maintain the normal output for a period of emergency. Finally, of course the capacities of all units, of conveyors, elevators, charging hoppers, mixers, buckets and chutes, have been regulated to the same nominal capacity, which is 1800 to 2000 cu.yd. per day.

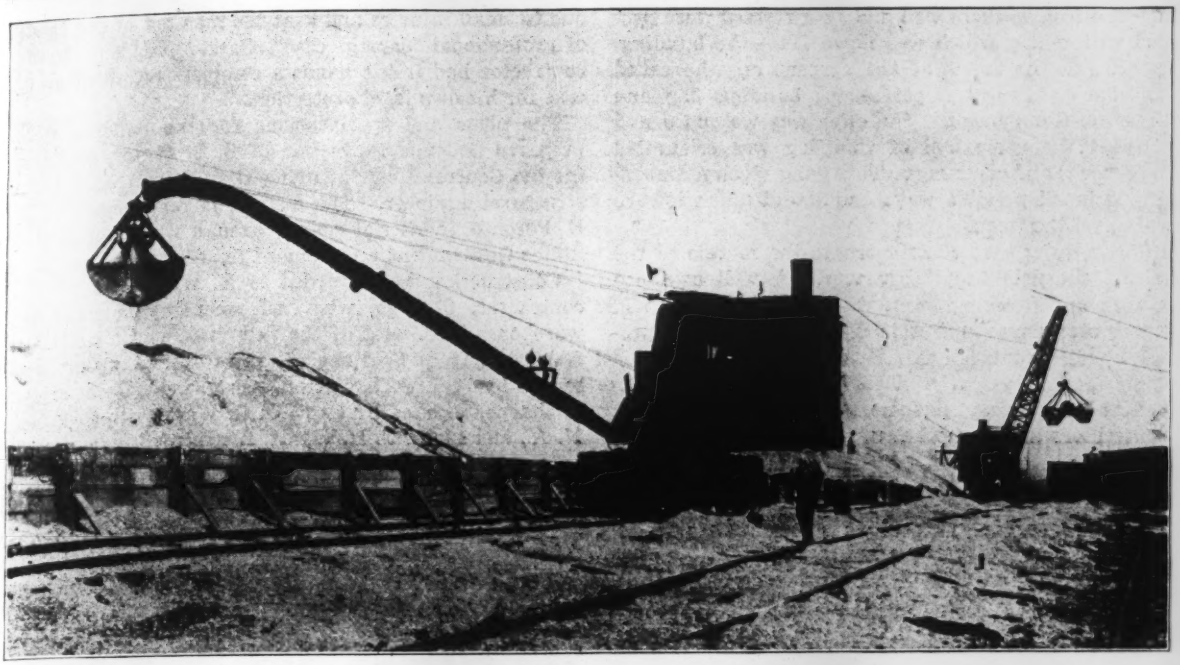

Head House Enclosing Motors
4-Stands of legs-85'high each driven by separate motor
Drive Pulley
Elev. Head Pulleys
30 H.P. Motor
Gravel Chute
Sand Chute
Pipe Grid for dumping Cement
Cement Handling Floor
14'6"
38'6"
Cement Bin
Gravel Bin
Sand Bin
Gravel Chute
Sand Chute
Cement Chute
2-Mixers 87 Cu. Ft. Capacity
Batch Charging Hopper
Mixers driven by steam engines furnished by central battery of boilers
12"x12" Post
Sand or Gravel First Storage Bins
Double strand chain 8"x 18" steel elev. cups, in each of four legs
Belt Conveyor from cars and shed to Work Floor
30" Belt Conveyor Motor Driven
Steel Elev. Cups Chain & Drag (4)
C.I. Boot
6 Yard Charging Hopper
8"x 8" Post
250' Tower Operating 4 Buckets

CONVEYORS, ELEVATORS, DISTRIBUTING TOWER AND QUADRUPLE CHUTES MAKE CEMENTING CONTINUOUS MECHANICAL OPERATION

Getting steel reinforcement and form lumber to the workmen was planned with as careful an eye to coördination as were the concreting operations. The first step was field shop fabrication to as great a degree as possible, the next was the planning of special "long-stuff" hoists and the last was gang subdivision, which is considered later.

Field shops were established for fabricating reinforcement and form members and for casting concrete blocks to support floor slab bars. At the steel shops column spirals were assembled complete and bars were cut and bent. The sawmills cut all staging and bracing timbers to exact dimensions for erection, and here also column capital molds and floor lagging panels were fabricated complete. The block yards delivered, precast and cured, more than a hundred thousand 4 x 4 x 6-in. concrete "chairs" for slab rods.

These shops contributed to group handling and transportation. For example, all the reinforcement of a column was handled as a unit. Column head molds were handled assembled as units. Lagging boards were cleated together in three-board panels and one piece was handled instead of three. Furthermore, all reinforcing



LOCOMOTIVE CRANES UNLOAD SAND FROM STONE CARS INTO STORAGE BIN

rods, spacers and chairs for a complete panel were got together, hauled, hoisted and placed in a single sequence of operations. This was repeated for another panel and so on. Many similar methods were followed in handling form members. The handling crews, in a word, moved groups of members, each group containing all the members required for a unit of construction. By this means each handling crew gained the efficiency due to concentration of attention and each erecting crew could proceed from panel to panel without delay in sorting and rehandling and waiting for delayed deliveries of certain members. Special long material elevators, described on page 334, helped materially in speeding the handling of bars and lumber.

Subdivision of Duties Increased Labor Output

Manual operations comprised principally handling and placing reinforcement, erecting and dismantling forms and wheeling and placing concrete. Coördination in these operations followed two principal directions; obtaining maximum practicable subdivision of duties by having a separate trained crew for each operation and scheduling the performance of each crew so that it worked in coördination with other crews, either adjacent or remote.

The general organization of the construction force is explained by the diagram. Actual direction of construction work is in the hands of a general superintendent and a group of engineers, superintendents and foremen. Under these men the working force was so organized that each crew performed only a certain prescribed operation and by repetition became particularly rapid and exact in its work. Two examples will illustrate the system:

On the building the form erection gang comprises the following crews: (1) Sets the uprights and braces them; (2) places the top timbers and establishes levels; (3) sets the column forms; (4) lays the floor lagging; (5) greases the column forms. The reinforcing gang is divided into the following crews: (1) Carrying and laying slab rods; (2) spacing and wiring slab rods and placing concrete chairs; (3) setting column spirals; (4) bending down column verticals to be tied into the slab reinforcements.

Crew operations follow a regular order so timed that the various processes of erecting forms and placing reinforcement mesh with one another. This scheduling of work, though adhering to a general plan, is in the hands of the crew and general foremen, who shift their men and points of operations as need arises, so that all operations will coördinate in time and sequence. In a measure, the task is intricate. The secret of its successful performance lies in each crew having only certain fixed duties to perform and so becoming remarkably quick and accurate, and in centralizing the direction of the crews. This centralization is so close that quick shifts are possible when any operation begins to get out of step with the general march of the work.

Cultivation of Esprit de Corps Increases Efficiency

The great accomplishment in coördinating labor, after all mechanical helps are named, has been the creation of *esprit de corps* among the workmen. A number of things have contributed to this accomplishment. First has been, perhaps, the appeal to patriotism. Universal success has been won in promoting the sentiment that every man's activity is a direct help in winning the war. The methods, as always in such matters, are too intangible to be defined precisely. For example, however, when the Third Liberty Loan campaign was on, competition was started between different groups of workers to determine which could raise the greatest

sum. The iron workers won and as a reward were presented with a flag which was flown from the building. This aroused the spirit of the carpenters, who asked permission to present a permanent building flag and staff to the Government. The offer was welcomed and on June 1 the dedication of this flag was celebrated with speeches and ceremony. This gang rivalry was encouraged in all possible ways and it did much toward speeding up the work.

Another thing that contributed to the morale of the men was the field hospital service. A well equipped operating and dressing room with a trained nurse in constant attendance and a surgeon at call were provided by the contractors. Every hurt was treated promptly and competently. This had a marked inspiriting effect on the men. Economically it was a gain both to contractors and to workmen, as it reduced time lost due to small injuries and kept the men out of the hands of professional "damage case" sharks. Incidentally, the contractor had in his hands a complete record of every case for his own legal protection.

The plans and specifications for the building were prepared under the direction of S. Scott Joy, architect for the Central Manufacturing District and A. Epstein, structural engineer. The district is represented by H. E. Poronto, industrial agent, through whom the United States Government was induced to adopt this location.

Construction was awarded to E. W. Sproul, general contractor, Chicago, who had recently completed the warehouse, just west of the new ones, which contained 900,000 sq.ft. of floor space. The Government is represented by Maj. S. L. Nelson, consulting quartermaster in charge, assisted by Capt. O. C. Waterman, Q. M. C., N. A., and Lieut. F. H. Wyatt, Engineer Reserve Corps.

New Orleans Builds Inner Harbor and Navigation Canal

Rush Construction with State Funds To Provide Ocean Docks and Industrial Sites on Fixed Level Waterway Between Mississippi River and Lake Pontchartrain

AN INDUSTRIAL water terminal along a new navigation canal through the city is being built at New Orleans, La., by the controlling port authority, known as the Board of Commissioners of the Port of New Orleans. The project is unique in its construction and remarkable in its engineering design and in the rapidity with which it is being put through. When it is completed New Orleans will have, well within the city, ocean docks and industrial sites on deep, still, practically fixed-level water, accessible to rail, highway and ocean-going traffic. The long-standing impediments to waterway development imposed by the variable level of the Mississippi will be removed.

The canal, nearly six miles long, will have a depth of 30 ft., a bottom width of 150 ft., a water-level width of 330 ft., and will extend from the Mississippi River to Lake Pontchartrain. In its ultimate development it will be provided with industrial basins and ocean docks all along its length and have a lock with 30 ft. over the sills, a usable length of 600 ft. and a usable width of 75 ft., to preserve the canal level at that of the lake, which varies only a foot or so. The Mississippi has a flood variation of nearly 20 ft. at New Orleans.

The inner harbor and canal project has quite a long history. Its need grew out of two things: the system of Government control of the riparian property under the laws of the State of Louisiana and the physical disqualifications of the Mississippi River as a terminal harbor or for industrial sites requiring water entrance. Under the laws of the state the banks of all navigable rivers are public, and the riparian proprietor can never acquire a complete dominion over the river front, but holds the property subject to the right of public use. This rule has descended from the earliest settlement of Louisiana, all French and Spanish grants having been made with this reservation. Furthermore, in municipalities of more than 5000 population, the Louisiana constitution requires that before the riparian proprietor can erect any structures on the river front he must obtain the joint consent of the Levee Board and the governing authority over the public wharves. In certain court cases it has been specifically stated that private lease of the river front gives only a temporary use. Naturally, under such a law large private interests are reluctant to attempt any extensive construction along the Mississippi River, and while the public control of the waterfront has in every other way been most desirable, it has served to restrict private construction.

Even if this law were subject to repeal or to constitutional amendment, the physical conditions of the Mississippi prevent any extensive use of its banks for industrial purposes. The river varies in its stage between +20 and +39 (Cairo datum), and the main part of the city of New Orleans is at El. 20 to 22. All river property, therefore, has to be leveed and is subject to the danger of overflow with loss of plant and property by the encroachment of the river. Furthermore, it would be necessary to locate any riparian plant far back of the levee and the wharves well out in front of the levee, requiring considerable expense in the handling of material. Any wharf or dock built in the river, too, must be designed to take care of material over this large range of water level and must, at the same time, be of sufficient stability and strength to stand the strain of the swift current of the river or of the drift accompanying the floods.

To avoid these two difficulties, the legal and the physical, it was proposed many years ago to cut through between the Mississippi River and Lake Pontchartrain a wide canal and to utilize the banks of that canal as a still, fixed water terminal. The matter was brought to a head by the crisis of the war and the obvious desirability of locating nearer New Orleans some of the many shipbuilding plants which had to be put up in the United States in a short period.

Consequently, early this year commercial bodies in New Orleans got together and guaranteed the purchase of bonds for the construction of an inner harbor and canal, to be issued by the Board of Commissioners of the Port of New Orleans under an act of the state

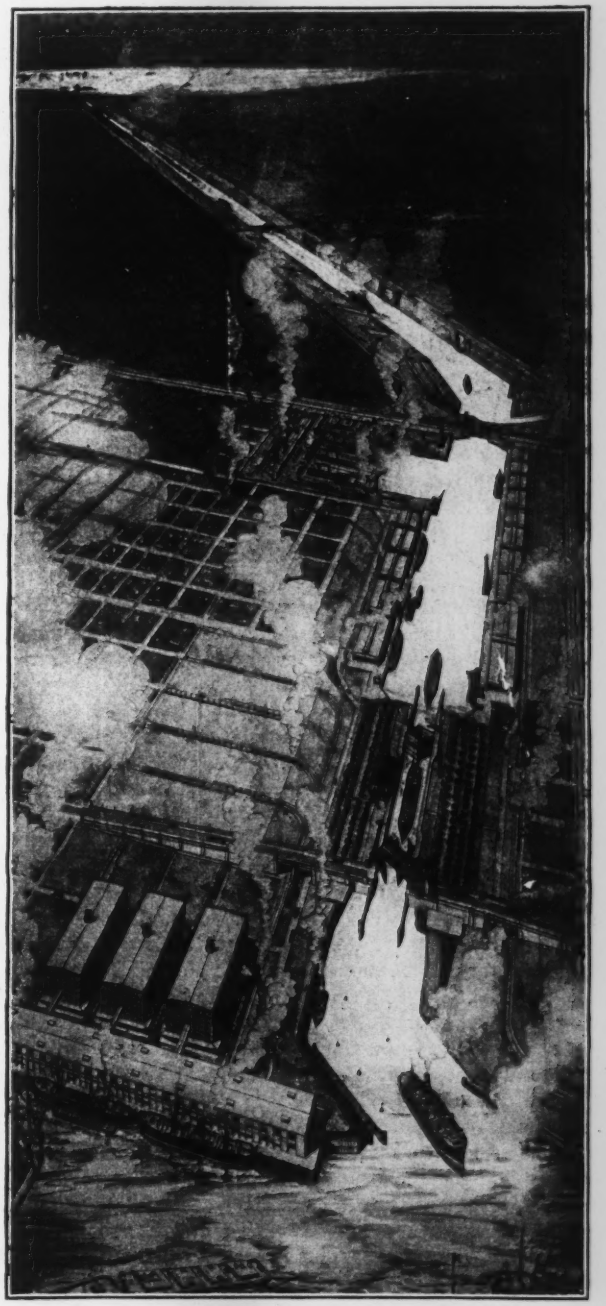
legislature of July, 1914. These bonds, to the sum of $6,000,000, bearing interest at 5%, have been sold, or are being sold, and work on the canal has been started. The United States Government was not asked for any assistance in the matter, except to permit the issue of the bonds. Under the act of 1914 the port commissioners, a state body, were authorized to construct and operate the canal and inner harbor, the location to be fixed upon to lie within the City of New Orleans, and the construction to be approved by the city and by the Board of Levee Commissioners of the Orleans Levee District and by the State Board of Engineers of the State of Louisiana. The Board of Commissioners further receives the right of expropriation of any property, although this right has not generally been exercised because it has been possible to purchase the property on the basis of reasonable valuations. The project is known officially as the Inner-Harbor-Navigation Canal of the Greater Port of New Orleans.

The location of the canal and inner harbor is shown in the accompanying drawing and a general sketch of the work is shown in the perspective sketch. It consists, as there shown, of a 30-ft. deep canal cut on 1 on 3 slopes through the alluvial soil of New Orleans from the Mississippi River to Lake Pontchartrain. The typical section has a bottom width of 150 ft., and a water level width of 330 ft. The trace of the canal, 5¾ miles long, is practically on two tangents, although there is a comparatively short turn at the river in order to permit easy access into the down current there. The width of the canal is sufficient to allow two ocean-going steamers to pass side by side, but it will be noticed that provision is made in the 2000-ft. restricted area extending 1000 ft. on either side of the center line of the canal for the diagonally placed ocean slips 225 ft. wide, 650 ft. long and 225 ft. apart. These also serve in lieu of turning basins; that is, a vessel in one of these slips backs out into the main channel and over into the opposite slip in order to turn to go out of the canal the same way in which it entered. The perspective also shows warehouses along the canal near the locks.

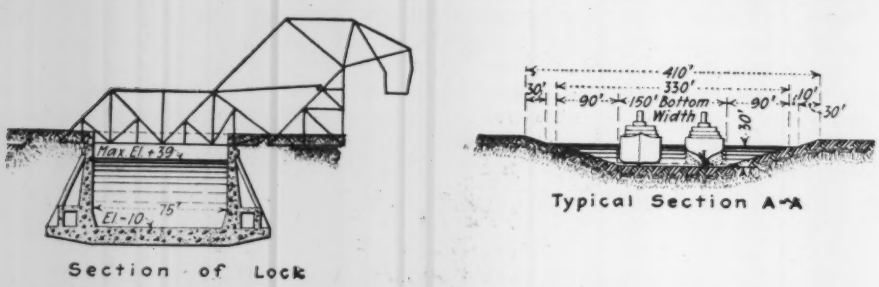
The canal is crossed with four bridges, one of which is at the head of the lock. These bridges each carry two-track railroad lines, two electric car lines, two highways, and two sidewalks and are to be of the Strauss bascule type. In addition, the canal crosses the main outfall drainage canal of New Orleans, which is to be carried under the ship canal at Florida Ave. in a reinforced-concrete siphon, designed for a flow of 2000 second-feet.

The lock is a remarkable structure. Rock here is about 1800 ft. below the surface of the ground, and the soil is extremely low in bearing value. The lock, therefore, had to be designed as a floating structure. A general outline of it is shown on the accompanying drawing. It has reinforced-concrete side walls which act as slabs, the water pressure being transmitted to the base through diagonal struts at the top, and portal box bracing of concrete at the bottom. The base, a thick concrete slab, rests on closely spaced piles driven within a sheet-pile cofferdam with a plan area somewhat larger than the plan area of the base of the lock.

The lock will have several double-skin flotation gates similar to those at Panama, but will be provided with gates mitering in either direction at each end of the lock in order to take care of the reverse pressure of the water due to the variation in the level of the lake and the river. As has been stated before, the river varies between +20 and +39 and the lake between +20 and +26. The pressure, therefore, may vary between 6 ft. against the river to 19 ft. against the lake. In addition to these gates taking pressure in either direction, the lock is provided with exceptional safety protection, because in certain relative stages of the river and lake the failure of the lock gates would precipitate a flood on a large area of the City of New Orleans, by way of the canal. The bridge across the head of the lock is



ARCHITECT'S PERSPECTIVE LOOKING FROM RIVER OVER CANAL AND INNER HARBOR TOWARD LAKE



SECTION THROUGH LOCK AND EXCAVATED CANAL

interlocked with the gates to form a barrier against ships, and there is in addition a revolving bridge mounted on the lock wall which will permit the ready placing of caissons across the lock in case of failure, in a manner similar to the stop log method, as commonly used on a smaller scale.

Long-time leases will be made between the Board of Commissioners of the port and concerns desiring to locate themselves inside the harbor area. Already two shipbuilding companies have located in the site.

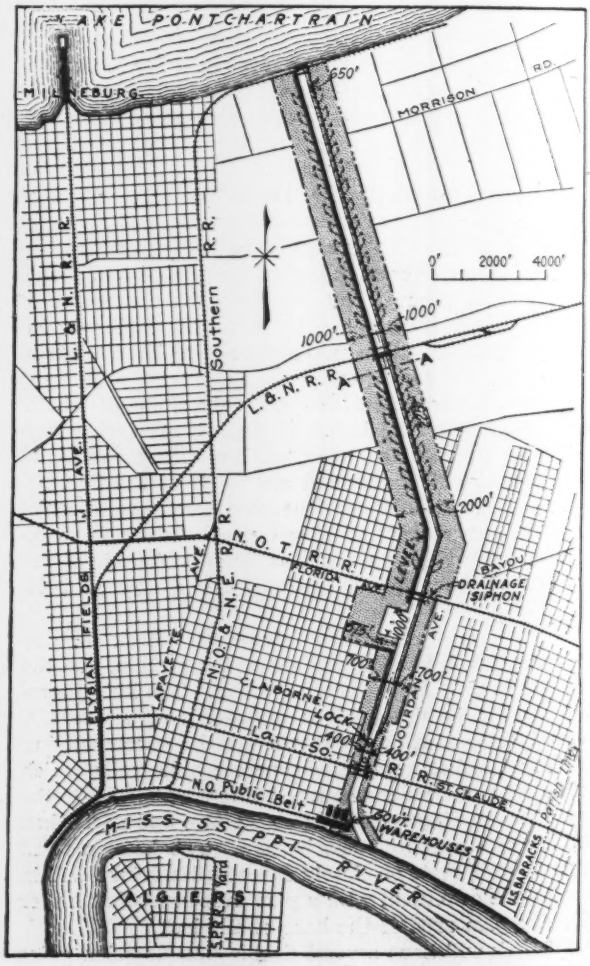
The Foundation Co. of New York has leased the rectangular plot of ground lying just south of Florida Ave. and is already far along on the shops and shipways in which it is to build steel ships for the French Government. A basin 1000 ft. long by 875 ft. wide is to be opened from the canal at this site. At the Lake Pontchartrain end of the canal the firm of Doulutt & Williams has a shipyard in which ten 9600-ton steel cargo vessels for the Emergency Fleet Corporation are being built. The waterway is just reaching both of these plants and it is expected that the latter plant will have sufficient water to permit the launching of its ships sideways into the canal by the time they are ready. These ships will be taken out via Lake Pontchartrain, which has a usable channel of 14 ft., to the ocean. The Foundation Co.'s ships will be launched into the open basin which is being dredged immediately in front of its yard, and may be taken out to sea through Bayou Bienvenu, which temporarily enters the canal about 1000 ft. below the shipyard.

At the Mississippi River entrance to the canal commodity warehouses shown in the perspective have just been started and have been taken over by the United States Government for use as quartermaster stores. The whole canal area, as shown in the drawing, and better in the ideal view of the perspective, is tied up to the belt line railroad of New Orleans, which connects with all of the railroads entering the city.

While it is intended that the canal will be used mainly as an inner harbor, the possibility of its use as a traffic-way has also been considered. The route from New Orleans to New York will be shortened 160 miles by the use of the canal and Lake Pontchartrain. At present there is only 14 ft. of water along the inland section of this rout, as compared with the 30 ft. which can be had down the Mississippi to the Head of the Passes.

Construction is being carried on under force account by the Board of Commissioners of the Port of New Orleans of which W. B. Thompson is president and J. Devereux O'Reilley is chief engineer. A report was made on the general project to the board, at the time of the constitutional amendment following the act of 1914, by Ford, Bacon & Davis, consulting engineers. The present location of the canal follows somewhat one of the location indicated in this earlier report. The design under construction was made and the construction is in charge of the firm of George W. Goethals & Co., consulting engineers, New York, and is under the direct charge of George M. Wells, a member of the firm, as consulting engineer. Henry Goldmark, designing and consulting engineer, is in charge of detailed designs of gates and machinery.

Speed is of the essence of the work. Normally, it is about a three years' job, but it is hoped to complete the whole work in 18 months. Work was started May 20, when hydraulic dredges were brought into Lake Pontchartrain and commenced digging toward the river. It is hoped to have the entire channel from the lock location to the lake completed by January, 1919, and the lock completed by a year from that time. Already five



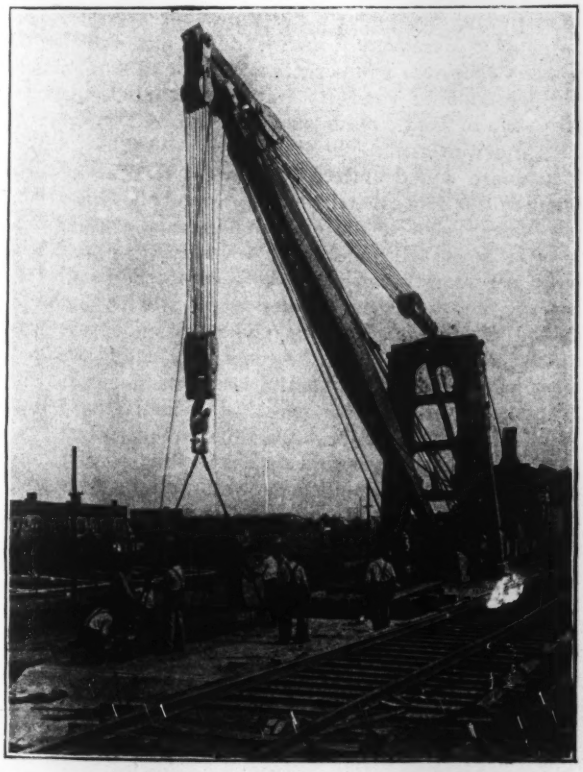
NEW CANAL CONNECTS MISSISSIPPI THROUGH CITY OF NEW ORLEANS TO LAKE PONTCHARTRAIN

hydraulic dredges are working at various points along the canal, having been brought in from Lake Pontchartrain and also through Bayou Bienvenu, which is near enough so that the dredges can dig themselves to the canal. After the lock is completed the short section between the lock and the river will be opened and the canal completed. The total cost at present is estimated to be about $6,000,000.

Derrick Car Places Deck Slabs of Concrete Bridges

Railway Has Powerful Machine for Handling Heavy Construction on Concrete and Steel Bridge Work

FOR handling and placing the heavy deck slabs of reinforced-concrete subway bridges on the Chicago track-elevation work of the Illinois Central R.R., the railway uses an exceptionally large derrick car. These slabs weigh from 18½ to 33½ tons. The derrick, which forms a part of the equipment of the bridge department of the railway, is of steel construction, with heavy plate-girder sills. It is 50 ft. long and weighs about 100 tons. The front end is carried by a special Bettendorf truck of 150 tons capacity, placed directly under the A-frame. A 50-hp. engine at the rear of the car operates the hoists and also operates a chain propelling gear which gives a speed of 12 miles per hour. The engine and boiler space is inclosed by folding panels when the machine is not in use. Fuel and water are carried in a tender coupled to the rear of the car. Box-girder construction is employed for the A-frame. This is mounted in shoe plates over the truck bolster, so that for transportation it can be laid back in an inclined position over the deck of the car. A central steel tie or tension member, which is anchored to the deck framing of the car, takes the strain of the load in hoisting.



DERRICK CAR WITH TIMBERS UNDER A-FRAME PLACES DECK SLABS FOR SUBWAY BRIDGES

A-FRAME OF DERRICK CAR HAS HINGED TENSION MEMBER AND SPUD TIMBERS UNDER CAP

Pin-connected joints in this member enable it to fold up as the A-frame is lowered. A T-shaped head is a special feature of the A-frame. This provides for supporting timbers or spuds which are set on blocking and wedged tightly against the head, thus relieving the load on the car frame and truck when the boom has to make a side swing, as in taking the slabs from the cars. The height from the rail to top of the A-frame when raised is about 28 feet.

Box-lattice girder construction is used for the boom,

the side members being built-up fish-belly girders of channel section, with double lacing inside the top and bottom flanges. The lacing is replaced by solid plates at the middle, where a bolted joint provides for placing a removable section 12 ft. in length. The normal length of the boom is 50 ft., with a hoisting capacity of 25 tons on a reach of 35 ft. There is also a 67½-ft. boom, with a lifting capacity of 50 tons on a reach of 30 ft. For work where the loads do not exceed 35 tons an A-frame of lighter construction is used. During transportation the boom is lowered to rest upon a heavy timber horse on a flat car coupled ahead of the derrick car.

The ponderous hoisting blocks and tackle are a striking feature of the equipment. The blocks weigh from 1 to 1.3 tons each. For the main hoist there is a six-part tackle with ⅞-in. wire rope in heavy steel blocks. The lower block carries an immense hook. The upper one is suspended by bar links from the head of the boom. For the topping lift there is also a six-part ⅞-in. tackle, rove through blocks attached by bars to the head of the boom and the cap of the A-frame. In handling the slabs, a wire-rope sling is used. This has a shackle which is placed on the main hoisting block, while the ends of the sling are attached to stirrups embedded in the concrete.

This derrick car is used in erecting heavy steel structures as well as in the handling of the concrete slabs noted above. The information contained herein has been furnished through A. S. Baldwin, chief engineer of the Illinois Central Railroad.

War Burdens of Water-Works of United States Increase

From a Report to the Executive Committee of the American Water-Works Association, Made by Leonard Metcalf, George A. Johnson and George W. Fuller

Returns from about fifty municipally and corporately owned plants indicate that labor costs were 13% higher in 1916 and 27% higher in 1917 than before the war, while labor has decreased 25 to 35% in efficiency. Construction costs have more than doubled. Coal and fuel oil for water-works operation have also more than doubled and chemicals have gone up 50 to 100%. Normal annual increase in revenue has generally declined. Net revenues, available for capital charges and profits, have remained about stationary, as a rule, instead of showing substantial increases, thus indicating that new investment is not being taken care of and that the divisible revenue is declining.

WATER-WORKS have suffered large increase in construction, operation and maintenance costs, due to war conditions. Marked decline in net revenue has resulted.

These conditions began to be generally felt late in 1916, but it was not until the latter part of 1917 that they became serious. Water-works employees were true to their tasks; the desirability and continuity of their employment tended to stay the advance in their wages, which lagged behind the general advance in wages paid to labor, by a period of eighteen months, more or less. Men working in contractors' forces, in munitions and allied works, had long enjoyed very substantial and, in some war industries, abnormal increase in wages, before the increase came to water-works employees.

But the advance in labor cost to American water-works has gathered force in the last six months, and it is the general opinion of municipal and corporate managers that additional increases are certain to come during 1918 and thereafter, if labor is to be held. It is certainly undesirable to replace old well trained forces, familiar with these properties, with other labor not having this familiarity, in the effort to hold the wages at a point below the general local standard for similar service. The character of the service would suffer. Serious and conscientious effort has been made by water-works operators generally to reduce construction and operating forces and expenses to a minimum. These reductions have in many cases gone beyond desirable limits, even to reducing the working efficiency of the properties.

The general situation is a very serious one, from the point of view of the public, and an anxious one for the managers of water-works. Already it has shown itself in increasing difficulty, and in many cases impossibility, of attracting capital to water-works for necessary betterments. Moreover, it is inevitable that the Capital Issues Committee will scrutinize more and more closely the diversion of funds to water-works needs, particularly where those needs are not involved by governmental activities.

Pressure will doubtless be brought to bear to force communities to husband their water supplies, by reducing waste, leakage, and even unnecessary consumption, in order to curtail unnecessary investment in plant thus made necessary. No doubt, here as abroad, there may come a time when the smaller works will be unable to extend their service during the duration of the war, unless government needs be concerned, but it would be most unfortunate if the activities of an important city or of communities with manifold industrial and commercial industries were to be thus circumscribed.

The menace of the situation lies in the increasing difficulty, under such conditions, of maintaining constantly a water service, safe from a sanitary standpoint, necessary for good fire protection service, and adequate to

TABLE I. PRICES PAID FOR CAST-IRON PIPE IN SEVEN CITIES, F.O.B. DESTINATION, TONS OF 2000 LB.

	1915		1916		1917		1918	
	Tons	Weighted Average Cost	Tons	Weighted Average Cost	Tons	Weighted Average Cost	Tons	Weighted Average Cost
Chicago, Ill.	27,765	$21.86	20,681	$27.54	15,255	$34.95	...	...
Columbus, O.	2,606	21.50	950	30.51	1,238	43.23	...	...
Cincinnati, O.	8,500	22.37	4,592	27.71	1,179	41.26	...	...
St. Louis Mo.	2,626	22.93	1,764	29.95	998	62.00	...	...
Terre Haute, Ind.	47	21.28	357	29.59	37	54.35	...	...
Evansville, Ind.	801	21.00	1,152	25.52	676	38.25	...	...
Weighted average of 6 cities	...	21.82	...	28.47	...	45.67	...	...
Indianapolis, Ind.	2,150	21.38	1,794	25.58	2,046	45.88	113	$54.78

industrial, commercial and domestic needs.

It appears clear that average pre-war prices will never again be realized and that the purchasing power of money has declined permanently the world over, as a result of the war, and will never be fully recovered. Present prices, which on most water-works materials are double pre-war prices and on labor 25 to 50% greater, will probably not hold permanently after the war. Nevertheless, the old prices for materials and labor will not return as a whole.

Replies received from various municipally and corporately owned properties in this country, show the rapid change in conditions facing water-works in this country from the years 1914 and 1915, which reflect the pre-war conditions, to the early part of the year 1918. All evidence available points to yet more trying conditions for the future.

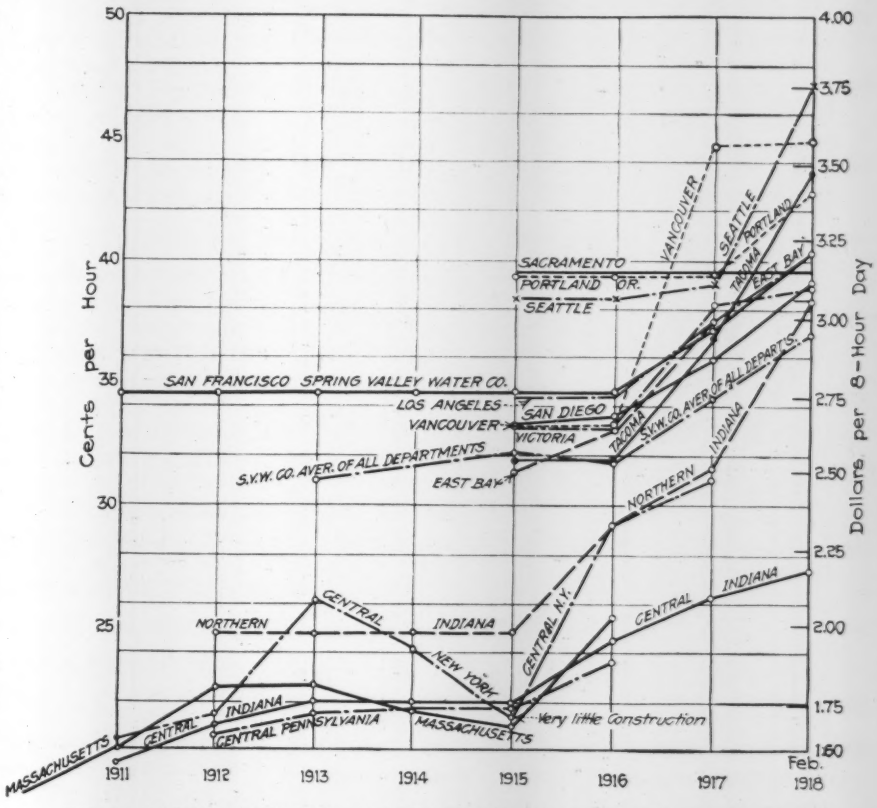


FIG. 1. LABOR COSTS PER MAN-HOUR PAID BY AMERICAN WATER-WORKS

For the works in the West the curves are based upon the actual average cost per man-hour of a gang of 50 men comprising foreman, subforeman, 4 calkers, 6 pipe layers, blacksmith and 37 laborers. For Indiana and the remainder of the East the curves are based on the actual gangs used. No allowance is made for the very serious loss in comparative efficiency of labor of which all making reports speak

The yearly average cost in cents per hour of unskilled labor to 44 American water-works, arranged in four local groups, indicate an average advance over pre-war prices prevailing in 1915 of 13% in 1916 and 27% in 1917, the fragmentary figures submitted for the opening of 1918 showing materially greater increase. It is important to note that comparison of past and present wage scales does not tell the whole story of increase in cost of labor to water works. Unfortunately, there has been marked decrease in efficiency. Your committee has made personal inquiry concerning this, within the last two months, from the managers of municipal as well as of corporate works, from the Pacific Coast to the East, and from the North to the South. In all cases, decrease in efficiency was reported. The estimates of percentage loss in efficiency, comparable with the efficiency of 1915 and prior thereto, varied from 20 to 50%. The consensus of opinion seemed to range between 25 and 35 per cent.

It thus appears that the loss in efficiency of labor is practically equal to its increase in wage. The full increase in cost of labor, due to the combined effect of loss in wages and loss of efficiency, is approximately 50% in excess of the pre-war costs and nearly as much over those of 1916.

Similar data were gathered by one of the members of this committee, at a slightly earlier date, with reference to the advance of labor costs in different parts of this country. (See Fig. 1.)

[Further construction cost data are given in Tables 1, 2 and 5.—Editor.]

Turning now to important typical operating supplies, such as coal and alum, yet greater increase in price has taken place.

Coal. The prices paid for coal by 41 important water-works, indicate an advance in prices in 1916, 1917 and early 1918, over those prevailing in 1915, of approximately 15, 74 and 117%, respectively. It is interesting to note the variation in the different parts of the country. The East suffered in far greater measure

TABLE II. WEIGHTED AVERAGE COST OF CONSTRUCTION MATERIALS TO THE INDIANAPOLIS WATER CO., 1915, 1916, 1917 AND THREE MONTHS OF 1918

Item	Unit	1915	1916	1917	1918 Three Months	Increased 1917 or 1918 Over 1915, Per Cent
Cast-iron pipe	Ton	$21.38	$25.58	$45.88	$54.78	156
Cast-iron fittings	100 lb.	2.502	2.75	4.19	.....	67
Pig lead	100 lb.	4.469	6.555	10.77	.....	141
Jute	100 lb.	6.50	7.75	10.50	.....	61
Valves, 6-in.	Each	11.25	13.88	18.77	.....	67
Valves, 12-in.	Each	33.00	39.33	52.50	63.00	91
Valve boxes	Each	1.60	2.03	2.35	2.72	70
Hydrants — 2-way and steamer	Each	33.50	39.44	54.77	.....	63
Corporation cocks, ¾-in.	Each	.32	.....	.713	.84	162
Stop boxes, 3-in.	Each	.63	.75	.91	1.27	101
Brick, common	1000	8.00	8.50	10.50	13.00	62
Paving, common	1000	35.00	.....	.....	.....	...
Cement, sacks inc.	Bbl.	1.80	1.959	2.207	3.00	66
Meters, ¾-in.	Each	6.99	8.40*	9.86	10.50†	50
1-in.	Each	10.50	.....	14.83	.....	...
1½-in.	Each	14.00	.....	19.50	.....	...
2-in.	Each	41.65	.....	62.36	62.50†	...
3-in.	Each	70.80	.....	85.00	.....	...
Lumber, Y. P.	M	26.00	33.00	37.50	44.00	69
Sand and gravel	Load	.....	.....	.....	.....	...
Reinforcing steel	100 lb.	2.55	3.15	3.50	4.00	57

*Few purchases. †Quotations.

TABLE III. PRICES PAID BY THE SPRING VALLEY WATER CO. SAN FRANCISCO

Material	Price Normal	Price January, 1918	Percentage of Increase Per Item	Percentage of Increase Weighted Average
Oil, fuel, per bbl.	$0.70½	$1.45	106.0	
Oil, cylinder, per gal.	.53	.86	36.5	
Packing, flax, per lb.	.40	.81	102.5	
Tubes, boiler, per ft.	.32	.84	162.0	99.5
Valves, rubber, per lb.	.70	.90	28.5	
Waste, cotton, per lb.	.09	.15	66.5	
Oil, dynamo, per gal.	.36	.531	47.5	
Waste, cotton, per lb.	.09	.15	66.5	50.0
Polish, metal, per gal.	.85	.90	6.0	
Cheese cloth, per yd.	.03¾	.10½	180.0	180.0
Hay, per ton	18.00	30.00	66.5	66.5
Copper sulphate, per 100 lb.	5.50	10.75	95.5	95.5
Paint, per gal.	.65	1.10	69.5	69.5
Hay, per ton	18.00	30.00	66.5	66.5
Asphaltum, per ton	12.50	17.60	40.0	
Coal tar, per bbl.	6.00	12.00	100.0	
Oakum, per bale	4.50	8.75	94.5	
Lumber, base	12.50	24.00	92.0	74.0
Nails, per 100 lb	2.35	4.70	100.0	
Paint, per gal.	.65	1.10	69.5	
Paint, per gal.	.65	1.10	69.5	
Lumber, base	12.50	24.00	92.0	85.0
Nails, per 100 lb	2.35	4.70	100.0	
Paint, per gal.	.65	1.10	69.5	69.5
Meter parts			20.0	
Fittings, brass, per lb.	.35	.57½	64.5	
Fittings, galvanized	List less 85%	List less 65 and 10%	110.0	60.0
Covers, meters, per lb.	.03½	.06¼	78.5	
Leather, per lb.	.40	.70	75.0	
Picks, per dozen	6.50	12.75	96.0	
Shovels, per dozen	11.00	18.50	68.0	
Cutters, pipe, each	1.50	2.75	83.5	
Stocks and dies, each	5.00	8.00	60.0	60.0
Wrenches, each	.75	1.50	100.0	
Pipe, cast-iron, per ton	35.00	62.00	76.5	
Fittings, cast-iron, per lb.	.03½	.06¼	78.5	
Lead, pig, per lb.	.04¼	.07	65.0	
Jute, per lb.	.06	.12	100.0	
Coal, per ton	10.00	13.00	30.0	70.0
Picks, per dozen	6.50	12.75	96.0	
Shovels, per dozen	11.00	18.60	68.0	
Bars, crow, per lb.	.04	.10	150.0	
Fittings, brass, per lb.	.35	.56½	64.5	
Fittings, galvanized	List less 85%	List less 65 and 10%	110.0	
Pipe, galvanized, per cu.ft.	4.50	10.05	124.0	
Pipe, lead, per 100 lb.	6.50	10.75	65.5	
Picks, per dozen	6.50	12.75	96.0	87.5
Shovels, per dozen	11.00	18.50	68.0	
Cutters, pipe, each	1.50	2.75	83.5	
Stocks and dies, each	5.00	8.00	60.0	
Wrenches, each	.75	1.50	100.0	
Leather, per lb.	.40	.70	75.0	
Office furniture			40.0	
Stationery			50.0	0.0
Printing			33.0	
Office furniture			40.0	
Stationery			50.0	
Printing			33.0	
Hardware, builders'			50.0	50.0
Shellac, per gal.	1.28	3.20	150.0	
Janitor's supplies			50.0	
Lumber, per base	12.50	24.00	92.0	
Nails, per 100 lb	2.35	4.70	100.0	
Fencing, per 100 lb.	2.65	5.55	109.5	80.0
Paint, per gal.	.65	1.10	69.5	

than the South and the West; the Central States in like measure with the Southern and Western states in the years 1916 and 1917, and in greater measure than any of the other groups in 1918. Incidentally, it may also be noted that the prices of fuel oil reported for one large plant in Louisiana and one in California show an advance in price in the opening of 1918 of approximately 150% over those prevailing in 1915.

Unfortunately, in coal as in labor, the advance in unit prices does not reflect the entire increase in cost, inasmuch as decline in quality of the coal has been very generally observed. Effort was recently made to obtain exact information upon this subject by the Indianapolis Water Co. through a study of the relative coal consumption per million gallons of water pumped during the past two years, or thereabouts. The results of this study indicate a decline in quality of the coal of from 10 to 15%, broadly speaking. The results are characteristic, rather than precise.

Carleton E. Davis, chief of the Bureau of Water of Philadelphia, reports that at one of their main pumping stations the increase in coal consumption during the past twelve months or so was 17.3% per million gallons pumped, because of the inferior quality of the coal. At other stations a change in the type of pump or character of fuel used makes a comparison impossible.

Advance in price of alum. The record of prices paid by water-works for alum, in cents per pound, is interesting and significant. It is to be borne in mind, however, that it reflects the leveling effect of long-time contracts under a rising market. This is indicated by comparison of the prices submitted, with the average New York market prices, quoted from the *Journal of Industrial and Engineering Chemistry.*

The figures submitted indicate an advance in 1916 and 1917 over the prices of 1915, of approximately 30 and 34%, whereas the advance in the New York market prices over the 1915 scale was 123% in 1916, and approximately 72% in 1917, the decline in the latter reflecting governmental control.

Some other operation supplies. Table 4 shows prices for sundry operating and maintenance supplies paid by the Indianapolis Water Co., 1915, 1916, 1917 and 1918.

Summary. In Table 5 are summarized the increases in cost of labor and materials, already referred to.

Water-Works Operation and Maintenance Costs

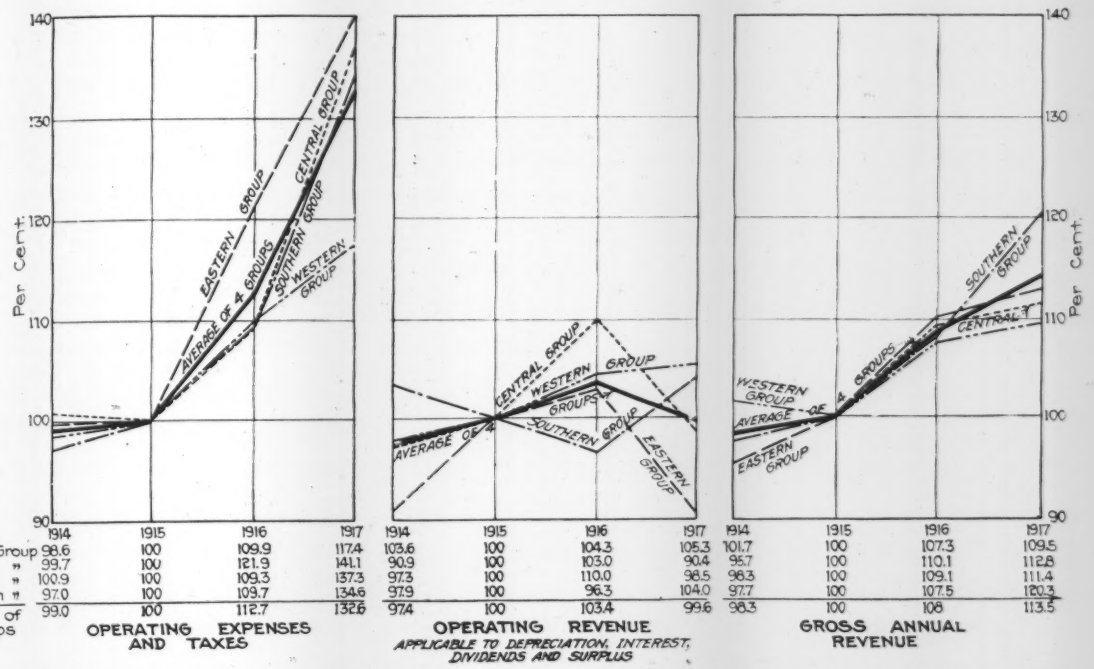
Returns were received from about fifty important water-works concerning their gross annual revenue, operating expense including taxes but excluding depreciation allowance, and the resulting operating revenue applicable to depreciation allowance, fixed charges, dividends and surplus. These records (see Fig. 2) indicate, as do the construction records, that no marked change in conditions was felt until 1916; that the gross annual revenues for 1916 and 1917 were respectively 6 and 9% in excess of those for 1915, but slightly more than those for 1914 on the basis of all of the records received, or 8.5 and 13.5% on the basis of the average of group averages. The normal advance in gross revenue, corresponding to the growth in population and in investment, would probably have exceeded 6% per annum and may have been substantially greater than this amount.

The increase in operating expenses over those of 1914-1915 was 6 and 19% for 1916 and 1917, respectively, on the basis of all the records received, and 12.7 and 32.6% on the basis of the average of the group averages.

TABLE IV. PRICES PAID FOR SUPPLIES USED IN OPERATION AND MAINTENANCE BY INDIANAPOLIS WATER CO., 1915, 1916, 1917 AND THREE MONTHS OF 1918

Item	Unit	1915	1916	1917	1918 Quotations	Per Cent Increase Over 1915
1. Coal	Ton	$1.45	$1.496	$2.439	$3.323	129
2. Alum	100 lb.	.861	.936	1.479	1.939	125
3. Chlorine gas	100 lb.	.....	12.50	12.50	15.00	20
4. Oil, engine	Gal.	.179	.195	.25	.35	95
5. Oil, hp. cylinder	Gal.	.349	.35	.44	.555	59
6. Oil, lp. cylinder	Gal.	.234	.25	.34	.555	137
7. Oil, linseed oil	Gal.	0.84	0.78	0.97	1.50	78
8. White lead	100 lb.	7.50	9.80	11.50	12.25	63
9. Electric power	Kw.H.	.01 / .0125	.01 / .0125	.015 / .0175	.015 / .0175	50* / 40*
10. Brass castings	Lb.	.22	.35	.45	.50	127
11. Special cast iron casting	Lb.	.0292	0.325	0.411	.0522	78
12. Steel boiler tubes 4 inches	Ft.	.1675	.2285	.55	.60	258
13. Printing bills	1000	.76	1.23	1.42	1.91	151
14. Heat (M. H. Lt. Co.)	Year	*Cont.*	*Cont.*	25%	Increase	25*
15. Rags (instead of waste)	Lb.	.05	.06	.07	.08	60
16. Gasoline	Gal.	.125	.175	.215	.25	100
17. Coal oil	Gal.	.07	.08	.10	.12	71

*Exclusive of demand charges.



	1914	1915	1916	1917
(8) Western Group	98.6	100	109.9	117.4
(18) Eastern "	99.7	100	121.9	141.1
(10) Central "	100.9	100	109.3	137.3
(13) Southern "	97.0	100	109.7	134.6
(49) Average of 4 Groups	99.0	100	112.7	132.6

	1914	1915	1916	1917
	103.6	100	104.3	105.3
	90.9	100	103.0	90.4
	97.3	100	110.0	98.5
	97.9	100	96.3	104.0
	97.4	100	103.4	99.6

	1914	1915	1916	1917
	101.7	100	107.3	109.5
	95.7	100	110.1	112.8
	98.3	100	109.1	111.4
	97.7	100	107.5	120.3
	98.3	100	108	113.5

FIG. 2. PERCENTAGE OF (1) OPERATING EXPENSES AND TAXES (2) OPERATING REVENUE APPLICABLE AS STATED, AND (3) GROSS ANNUAL REVENUE OF 49 WATER-WORKS IN 1914, 1916 AND 1917, TO SAME FIGURES FOR 1915

Of the 49 works compared, 8 are in the Western, 18 in the Eastern, 10 in the Central and 13 in the Southern group of States. The increase in operating expenses and taxes and the decrease in operating revenue will be still more marked in 1918

The resulting operating revenues applicable to the depreciation allowance, fixed charges, dividends and surplus for 1916 and 1917, were respectively 6 and 2% in excess of those for 1915, all on the basis of the average of all of the records received; and 3.4 and 0%, respectively, in excess of 1915, on the basis of the average of the four group averages.

Broadly speaking, therefore, it appears that the increase in operating expense has substantially absorbed the normal increase in gross revenue and has left no revenue to carry the burden of additional investments. There is marked decline in revenue in the eastern group, however.

Interesting similar data on increase in operating expense of some of the more important water-works in the United States are given in Table 6.

Records received from 50 typically important water-works in the United States, indicate:

(a) That the advance in the cost of labor used by water-works in construction work during the past three years was approximately 13% in 1916 and 27% in 1917 over the pre-war costs in this country. These pre-war costs were fairly reflected by prices prevailing in the year 1915.

Material decrease in efficiency of labor has also been observed in all parts of the country, the consensus of opinion indicating an approximate loss in efficiency of from 25 to 35 per cent.

(b) The important water-works construction materials, pipe, valves, hydrants, etc., have more than doubled in cost.

The more important operating materials, such as coal and fuel oil, have also more than doubled and chemicals for the treatment of the water have advanced from 50 to 100% and more.

(c) The normal annual increase in revenue of the water-works of this country has in general decreased, except where war activities have materially increased the local market for water.

(d) The operating and maintenance expenses have increased approximately one-third, the increase in gravity works being of less serious moment generally, than in the pumping plants.

(e) The net revenues applicable to depreciation allowance, fixed charges, dividends, and surplus have, in general, remained about stationary, instead of increasing substantially from year to year, thus indicating that the new investment is not being taken care of, and that the divisible revenue is declining. The conditions vary markedly at individual plants and in groups, the Eastern group showing the most marked decline in net annual revenues. Unfortunately the conditions are growing more and more serious.

CONCLUSIONS

1. That the water-works of the United States have suffered, through war conditions, large increase in construction and operation costs.

2. That marked decline in net revenue has resulted.

3. These conditions did not begin to make themselves generally felt until late in 1916, and it was not until the latter part of the following year that they became serious. The desirability and continuity of employment tended to delay the advance in wages.

4. The advance in cost of labor used in extension and minor construction work, by water-works in this country, has gathered force in the last six months, and it is

TABLE V. SUMMARY OF DATA UPON INCREASE IN COST OF LABOR AND MATERIALS TO WATER-WORKS IN THE UNITED STATES AS REPORTED TO THE EXECUTIVE COMMITTEE OF THE AMERICAN WATER-WORKS ASSOCIATION, MAY, 1918

	Item	No. of Records	Prices Per Unit				Per Cent. Increase Over 1915		
			1915	1916	1917	3 Months 1918	1916	1917	3 Months 1918
1	Unskilled labor*, c. per hr.								
	Western group	7	27.0	28.5	31.4	Still in-	5	16	Still in-
	Central group	12	21.7	25.3	26.9	creas-	17	24	creasing
	Eastern group	15	23.0	26.7	30.4	ing in	16	32	in all
	Southern group	10	17.9	20.6	24.5	all	15	37	groups
	Average of groups (4)		22.4	25.3	28.3	groups	12	27	
	Average of all	44	22.1	25.2	28.3		14	28	
2	Cast-iron pipe, per 2000 lb.	21	$24.23	$30.70	$51.60		26.7	112.9	
3	6-in. valves	11	11.18	12.64	19.13	$23.20	13.1	71.1	107.6
4	12-in. valves	3	34.78	41.53	65.22	69.00	19.4	87.6	98.7
5	2-way hydrants	6	26.69	32.04	43.13	53.90	$20.1	$61.6	$102.0
6	Coal per 2000 lb.								
	Eastern group	13	2.98	3.80	5.96	7.04	27.5	100.0	136.3
	Central group	11	2.41	2.77	3.75	6.38	14.9	56.4	164.7
	Southern group	12	1.92	2.01	3.03	4.02	4.7	57.8	109.4
	Western group	5	3.97	4.37	6.31	7.89	10.1	58.9	98.7
	Average of groups (4)		2.82	3.24	4.77	6.33	14.9	69.2	124.4
	Average of all	41	2.62	3.04	4.52	5.69	15.3	73.7	117.1
7	Fuel oil, c. per gal.	1	1.80	1.80	2.00	4.50	0.0	11.1	150.0
	Fuel oil, c. per gal.	1	1.38	1.50	2.57	3.55	8.7	86.2	157.3
8	Alum, c. per lb.								
	Western group	2	1.14	1.21	1.51		6.1	41.4	
	Central group	5	0.91	0.91	1.25		0.0	37.0	
	Eastern group	9	1.12	1.72	1.48		54.0	32.7	
	Southern group	9	1.08	1.38	1.48		28.0	37.0	
	Average of groups (4)		1.06	1.30	1.43		23.3	35.1	
	Average of all	25	1.07	1.40	1.44		30.6	34.4	
	New York market price†	‡	2.08	4.63	3.57	3.15 (5 mos.)	123.0	71.6	51.4

*Note. It was generally reported that there has been also a marked decrease in efficiency of labor since the year 1914, variously estimated at between 20 and 50%; and that the increase in wages paid to labor by water-works had not kept pace with contract prices owing probably to the advantage of continuity of service.

†See *Journal of Industrial and Engineering Chemistry*. Note that 1915 price was an advance of 34% over the 1914 average price before the advances listed went into effect.

‡Average of monthly prices.

the general opinion of municipal and corporate managers that additional increases are certain to come during 1918 and thereafter, if labor is to be held.

5. It is undesirable to replace old, well-trained forces, familiar with these water-works properties, with other labor not having this familiarity, in the effort to hold the wages at a point below the general local standard for similar service. The character of the service would suffer and it would not be fair to labor.

6. Serious and conscientious effort has been made by water-works operators generally to reduce construction and operating forces to a minimum. These reductions have in many cases already gone beyond desirable limits, even to reducing the working efficiency of the properties. In other cases still greater economies are possible in better consumption of coal; waste reduction by increased use of controlling meters, pitometer surveys, and more frequent house-to-house inspection, and in quarterly instead of monthly meter readings of small meters.

7. The general situation is a very serious one and has shown itself in increasing difficulty of attracting capital for necessary betterments. While extension of service is likely to be increasingly limited with the conditions of war, it would be unfortunate, if the activities of important industrial and commercial centers, particularly those concerned in governmental activities, should be thus circumscribed.

8. The menace of the situation lies in the increasing difficulty under such conditions of maintaining constantly a water service safe from a sanitary standpoint, necessary for good fire protection service, and adequate for industrial, commercial and domestic needs.

9. Public service commissions and other regulatory bodies have already recognized the danger of the present situation to the public as well as to the utilities, and are likely at least to afford such relief as may seem to them necessary to maintain credit, but it is imperative for water-works operators to keep clear records, showing the actual change in conditions and prices of materials and labor, that these bodies may have incontestable proof upon which to pass judgment as to the necessity for relief.

10. It is imperative, in the interest of good service, that water-works operators of municipally as well as corporately owned plants, should anticipate their construction and operation needs, as far as possible, and should be careful to obtain the necessary priority orders, that the quality of the water and the service rendered may not be seriously impaired in the future for want of construction and operation materials and supplies.

TABLE VI. INCREASE IN OPERATING EXPENSES OF 29 AMERICAN WATER-WORKS

(Figures reported early in June, 1918, to F. C. Jordan, Secretary Indianapolis Water Co., showing increases in operating expenses during the past six months, as compared with the normal pre-war operating expenses.)

	Increase Over Normal Operating Expenses
	Reported Increase, Per Cent.
Savannah, Ga.	20
Richmond, Va.	25
Milwaukee, Wis.	36
Brockton, Mass.	28.6
Champaign, Ill.	30
Nashville, Tenn.	25
Mobile, Ala.	30
Philadelphia, Pa.	35
Jamestown, N. Y.	56
Toledo, Ohio	52
St. Catherines, Ont.	25
Elmira, N. Y.	33
Worcester, Mass.	35
Paterson, N. J.	16
Cincinnati, Ohio	25
Springfield, Ill.	20
Springfield, Mo.	25
Springfield, Mass.	17
Peoria, Ill.	25
Jersey City, N. J.	15
Decatur, Ill.	35
Cleveland, Ohio	31
Des Moines, Iowa	47
Schenectady, N. Y.	20
Xenia, Ohio	33
Flint, Mich.	18
Providence, R. I.	52
Colorado Springs, Colo.	25
Atlanta, Ga.	40
Kansas City, Mo.	35
Dayton, Ohio	21
Lansing, Mich.	30
Average	29

[The complete report has been printed in pamphlet form by the American Water-Works Association, whose address is 47 State St., Troy, N. Y.—Editor.]

Small Municipal Garbage Piggery Built

Municipal piggeries for the utilization of garbage are increasing in numbers in England. At Sowerby Bridge a small piggery, built at the site of the refuse destructor after plans made by F. Wilkinson, acting town surveyor, was recently put in operation. It consists of four 8½ x 11-ft. pens together with a 9 x 12-ft. cooking house. The latter is fitted with a steam jacketed boiler of 24 U. S. gal. capacity which is supplied with steam from the destructor. The floors of all the buildings are of concrete. Portions of the floors of the pig sties are covered with wood laths for the pigs to lie on. An outdoor runway 30 x 80 ft. in area is provided. The London *Surveyor* states that the piggery was opened about July 1 with the modest number of 14 pigs bought by the town council.

15,000-Car Hump Yard Near Chicago Planned by Illinois Central Railroad

Terminal for Main-Line Trains, from Which Transfer Trains Will Serve Local Yards, Will Have Power-Operated Switches, Motor-Car Service for Car Riders and L.C.L. Transfer Facilities for 450 Cars Daily

ONE large and entirely new freight yard is to be constructed in the Chicago district of the Illinois Central R.R. to replace several small yards and to eliminate switching work in these yards. It will be made the terminal point for road engines and freight trains, all movements north of the yard being of a transfer and interchange character. The improvement includes a station for handling less-than-carload freight, gravity switching, and a system of motor-car service and subways for the use of the car riders in returning from the classification tracks to the switching humps. The Illinois Central has at present two large yards at Chicago, used more or less both as switching points and as terminals for main-line trains. The plan is to use these facilities in future as freight-collecting and distributing points, served by transfer engines operating between them and the new yard. These engines will also handle the transfer or interchange of cars between this yard and the yards of other roads in the Chicago district.

The new yard will be between Harvey and Homewood, just south of the city limits and about 20 miles from the company's city terminal station. It is to be known as the Markham yard, and it is expected that construction will be started this year.

The possibility of future electrification of the Chicago terminal lines was among the factors considered in the location and design. The general layout is shown in the accompanying plan, but this is subject to change in matters of detail.

Main Elements of Yard

The main facilities will comprise receiving, classification and departure yards for both northbound and southbound traffic, a transfer yard for handling less-than-carload freight, a car-repair yard and an engine terminal. The general plan is a long and narrow rectangular site, having a bulge or extension on one side in which the northbound classification unit is located. This arrangement was governed partly by right-of-way considerations and partly by the fact that the distance between the two towns is too short to admit of an entirely longitudinal layout. With the two sets of classification tracks placed side by side and the spaces between their ends utilized for the car-repair yard and the engine terminal, respectively, the total length is reduced, and a compact layout is obtained.

The yard lies entirely to the east of the four-track main line. It will be 18,400 ft. long between end switches, with an area of approximately 500 acres and a capacity of about 15,000 cars. It will provide for handling a total of 50 trains daily and switching a total of 5000 cars daily.

For northbound or inbound traffic there will be the following accommodations: A receiving yard with 20 tracks and a capacity of 2390 cars; a classification yard with 78 tracks for 2960 cars, and a departure yard with 20 tracks for 1950 cars. This last will be for transfer trains to the local city yards and interchange trains for delivery to other railways. The length of tracks will be from 3600 to 5100 ft. in the receiving yard (80 to 116 cars per track); 1500 to 3000 ft. in the classification unit, and 3600 to 4000 ft. in the departure yard.

For southbound or outbound traffic there will be a receiving yard with 20 tracks of 1950 cars capacity; a classification yard with 40 tracks for 2050 cars, and a departure yard with 20 tracks for 2070 cars. The receiving yard will be for transfer trains from city yards and for interchange trains from the terminals of other roads. The length of tracks will be from 3600 to 3800 ft. in the receiving yard; 1500 to 3600 ft. (27 to 80 cars per track) in the classification unit, and 4500 to 5300 ft. (100 to 118 cars each) in the departure yard.

Lengths and Numbers of Tracks

Difference of service accounts for the fact that in the northbound receiving and southbound departure yards the tracks are longer than those in the southbound receiving and northbound departure yards. The first two yards are for main-line or full tonnage trains handled by the road locomotives. The other two yards are for transfer and interchange trains of the Chicago local district, which naturally will be much shorter than the main-line trains. A considerable proportion of the northbound or inbound traffic is in coal, and there is a correspondingly large proportion of empty cars going south. The northbound or inbound main-line trains have from 80 to 110 cars, while the southbound or outbound trains have from 90 to 120 cars, the difference being due to the empty coal cars. Transfer trains will average 75 to 80 cars.

Difference in the number of tracks in the two classification yards is due to the same condition. The 40 tracks of the southbound yard are sufficient to provide for the outgoing main-line trains. The northbound yard has 78 tracks to provide for the greater number of classifications due to the wide distribution and consequently larger number of relatively short trains for the inbound Chicago district freight. The northbound departure yard will have ample capacity for the transfer service, it is believed, in spite of its relatively small number of tracks, as in many cases these trains will be taken direct from the classification tracks and will not need to be held in the departure yard. The greater length of the departure tracks will allow solid trains to be made up for delivery to other roads.

The 20 tracks in each receiving and departure yard represent the full development of the property or space available. It is planned to construct at present only 10 tracks in each receiving yard. This number, it is

estimated, will take care of any ordinary emergency, such as the blocking of the hump for a time up to six hours.

The arrangement of ladder tracks in the classification yards was worked out with a view to getting the shortest possible distance from the hump to the last switch on the ladder, at the same time eliminating every curve that could be dispensed with. Plans of various other yards were considered, but none of these had the arrangement here adopted.

Gravity switching has been adopted for the classification work. The profiles for the humps conform to the arrangement used in other gravity yards on this road, their design being based on the grades of the main line and the average loading in both directions. Consideration is given also to the elevation required for subways carrying tracks under the switching humps. The grades proposed for the humps and approaches are shown on the profile and in the accompanying table. They are connected by vertical curves 150 ft. in length.

GRADES FOR SWITCHING HUMPS IN MARKHAM

	Northbound	Southbound
Approach	1,900 ft. level	2,700 ft. + 1%
To summit	500 ft. + 2%	1,100 ft. + 2%
Summit	75 ft. level	75 ft. level
Accelerating	150 ft. — 3%	400 ft. — 3.5%
Accelerating	400 ft. — 2%	450 ft. — 1.5%
Along the leads	1,000 ft. — 1%	800 ft. — 0.75%

Each hump will have two switching tracks, the one for general use being equipped with a track scale. The other track is provided in order to eliminate as far as possible any chance of the hump being blocked entirely in case of derailment, damaged scales or other accident that would tend to delay the regular movement of cars from the receiving yard to the classification yard. The design provides for access from each of these two hump tracks to every classification track. The scale is located on the 75-ft. level stretch at the summit of the hump, so that the kick off or initial push given to each car as it is uncoupled will carry it over the scale to the accelerating grade. Each track scale will be of 100-ton capacity, with a table 50 ft. long.

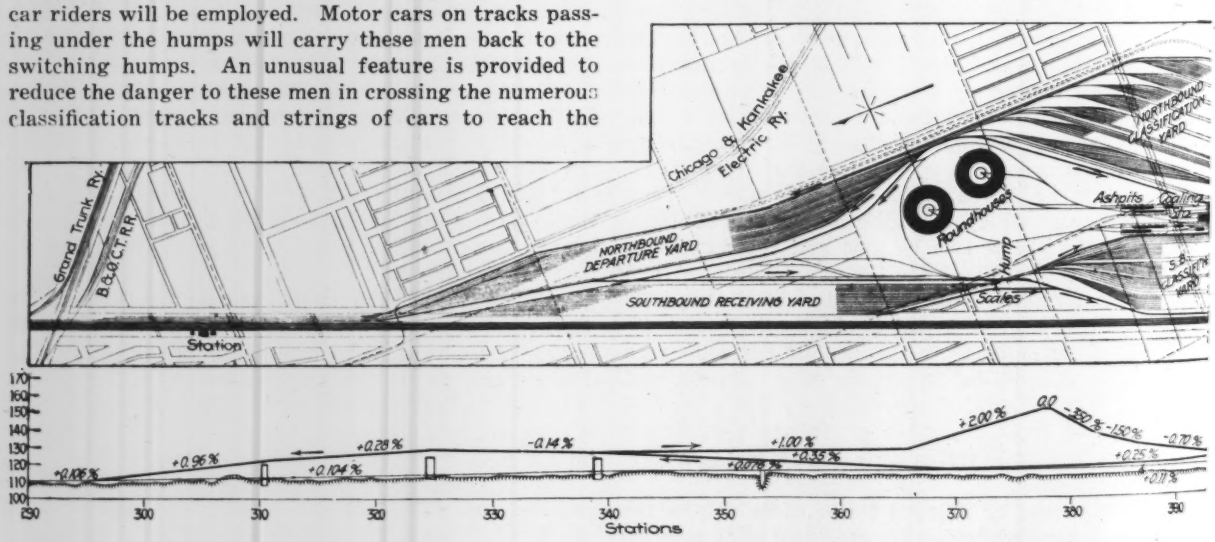
When the yard is worked at full capacity about 30 car riders will be employed. Motor cars on tracks passing under the humps will carry these men back to the switching humps. An unusual feature is provided to reduce the danger to these men in crossing the numerous classification tracks and strings of cars to reach the motor cars. This is the provision of concrete subways extending across the yard and made accessible by stairways at different points.

Spacing of all yard tracks will conform with the requirements of the Illinois Public Utilities Commission, noted in *Engineering News-Record* of May 31, 1917, p. 446; that is, a minimum of 13½ ft. will be used for body tracks and a minimum of 19 ft. for parallel ladder tracks, except that where switches are operated mechanically this latter spacing will be decreased to 17 ft. Tracks will be laid with 90- and 85-lb. rails. The turnouts will have 15-ft. switch rails and No. 8 frogs, on 1:8 ladders. No curves on yard tracks sharper than about 9° will be used.

Through interchange with the Chicago terminals of other roads, many cars entering the outbound or southbound classification yard will be destined for local yards of the Illinois Central north of this main yard. To provide for these there will be connecting tracks permitting such cars to be transferred by way of the lead from the south end of the southbound classification yard to rehumping tracks just west of the northbound receiving yard. Thence they will be passed to the northbound classification yard for arrangement in station order. It is intended that such movements will be made only from the most easterly two units of the southbound classification yard, as indicated by the plan. The two west units, on account of their length, will be used mainly for empty coal cars, empty box cars and grain cars for the South.

Northbound cars which need repair but which have been classified may be taken from the north end of the most easterly tracks in the northbound classification yard by a crossover connection between the switching lead of these tracks and an outer track. Over this track the cars may be moved south, passing under the hump, to the repair-yard leads located between the transfer station and the southbound departure yard. A second crossover connects the two repair-yard leads. From this point the cars will be switched into the south end of the repair yard.

Cars damaged to such an extent that it is not ad-



PLAN AND PROFILE OF PROPOSED MARKHAM YARD, FREIGHT TERMINAL TO REP
MAIN AND THOROUGHFARE TRACKS SHOW HEAVIER—

visable to pass them over the hump will be taken out of the south end of the receiving yard and over the repair-yard lead to the repair yard. When repaired, these cars may be pulled directly from the south end of this yard to the rehumping tracks west of the northbound receiving yard. Southbound cars requiring repair will be taken from the south end of the classification yard and passed through crossovers connecting with the two repair-yard leads.

Less-than-carload freight from local yards will be consolidated into full carloads according to destination and shipper, thus insuring full loads to cars in outbound main-line trains. For this service a transfer station is provided, having 12 tracks in pairs separated by five covered platforms 17 ft. wide and about 700 ft. long. This will provide for rearranging freight for loading about 450 cars per day. The Illinois Central has already a small layout on the same general plan, but the new design embodies several of the features of the large transfer station on the Pennsylvania R.R. at Northumberland, Penn.

Repairs to cars will be made on a group of 21 tracks, having a total capacity of 660 cars. The tracks will be 700 ft. long, and spaced 20 ft. on centers. For light running repairs there will be two tracks adjacent to each classification yard, so that a car can be hauled back and repaired and then again be passed over the hump for classification.

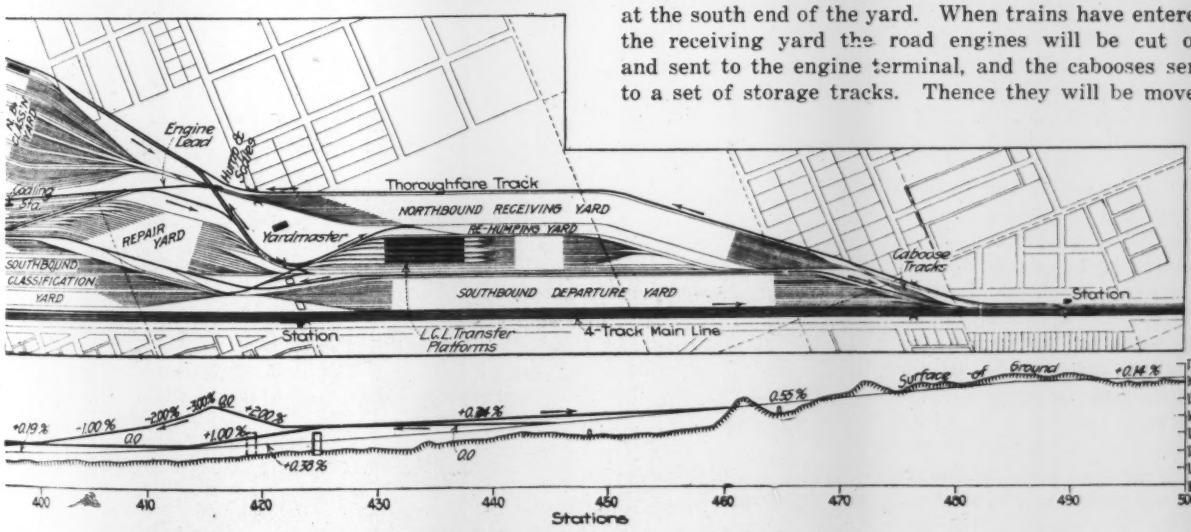
Repair shops and storehouses will be located near the yard. An icing station for the supply of ice to refrigerator cars will be placed east of and adjacent to the northbound classification yard. Piping for compressed air in the departure yards will provide for the testing of car brakes before the engines are coupled to the trains.

A thoroughfare track or engine lead passes on each side of each unit of the yard, except the west side of the southbound receiving yard. The tracks passing under the northbound hump are thoroughfare tracks, one of them to be used in moving cars from the northbound classification track to the transfer station or the repair yard. The track under the southbound hump is to allow southbound transfer locomotives to reach the locomotive terminal when it is impossible to use the regular inbound lead over the hump on account of the hump being occupied by trains.

Engine-terminal facilities will be provided sufficient for 40 road engines, 20 yard switching engines and 16 transfer engines. There will be two roundhouses, each forming a complete circle of 428 ft. outside diameter and having 40 stalls on tracks radiating from a 100-ft. power-operated turntable. The width of the house will be 114 ft. The coaling station will serve four engines at a time. Water will be pumped from the Calumet River to two elevated steel tanks and thence distributed to the shops and water cranes. For cleaning fires there will be two ashpits 320 ft. long. Inbound engines may sometimes be sent out again without going to the roundhouse. For this purpose a loop track of 626-ft. radius enables an engine to take coal and water and then pass to the outbound side of the yard, ready to take out a train.

Direct movement of inbound locomotives from the northbound receiving yard to the engine terminal is assured by a third track over the hump, so that these engines will not have to wait until the hump engine is clear of the regular switching track. This additional track is not necessary on the southbound hump, as an alternative means of access to the engine terminal is provided for the transfer engines which come in at the north end of the yard. This consists of the engine lead shown just west of the scale and connecting with the track which passes under the hump. Ordinarily the transfer engines will move over the hump and enter the south end of the engine terminal. In this movement they will use the lead or engine track provided specially for this purpose outside or east of the two light-repair tracks in the southbound classification yard. This lead connects with the corresponding lead over the northbound hump.

Gravity handling of main-line cabooses has been considered, but grade conditions seem to make this inadvisable, except that they will be delivered by gravity to the outbound trains. These cars are to be handled at the south end of the yard. When trains have entered the receiving yard the road engines will be cut off and sent to the engine terminal, and the cabooses sent to a set of storage tracks. Thence they will be moved



LACE SEVERAL SMALLER YARDS OF ILLINOIS CENTRAL RAILROAD AT CHICAGO—
TRACK SCALES ARE LOCATED AT TOP OF EACH HUMP

to a small gravity caboose yard north of the southbound departure yard, and from this they may be dropped into the trains standing in the latter yard.

Electro-pneumatic operation of switches of the classification tracks is provided for, with control from towers built over the humps. The yard entrances will be equipped with electro-pneumatic interlocking plants, For lighting the yards there will be electric lights of 500 cp. on poles about 26 ft. high and spaced from 200 to 400 ft. apart.

Preparation of the site will include a considerable amount of filling, as it is to be elevated about 10 ft. above the street level. This will be done by contract. A number of long subways will be required to carry streets under the yard, and some streets will be closed and diverted in order to clear the property lines of the new yard. A few of the subways will be for pedestrians only. All will be of concrete construction, with decks of precast slabs.

The design of this terminal yard has been made under the supervision of A. S. Baldwin, chief engineer of the Illinois Central Railroad.

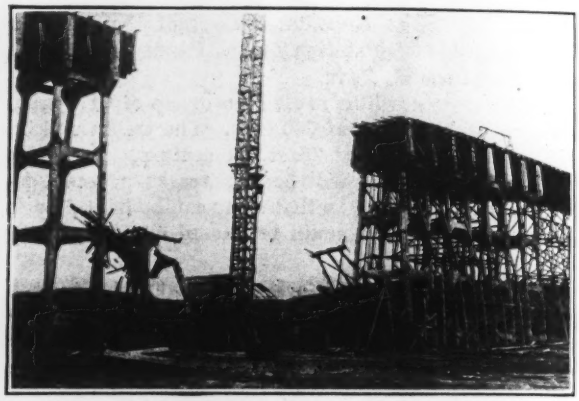
Temporary Timber Bents Rapidly Repair Destroyed Flume

Irrigation Trestle Being Replaced By Concrete Bents Collapses in Old Section But Is Soon Repaired

A 108-FOOT section of the high flume in the South San Joaquin Irrigation District system, California, collapsed during a windstorm on Feb. 19. The section destroyed was a portion of the old wood trestle 70 ft. high, the entire 2000-ft. length of which is being replaced a section at a time by a concrete structure, as described in *Engineering News-Record* of May 2, p. 869. A temporary wood section was put in place in 17 days.

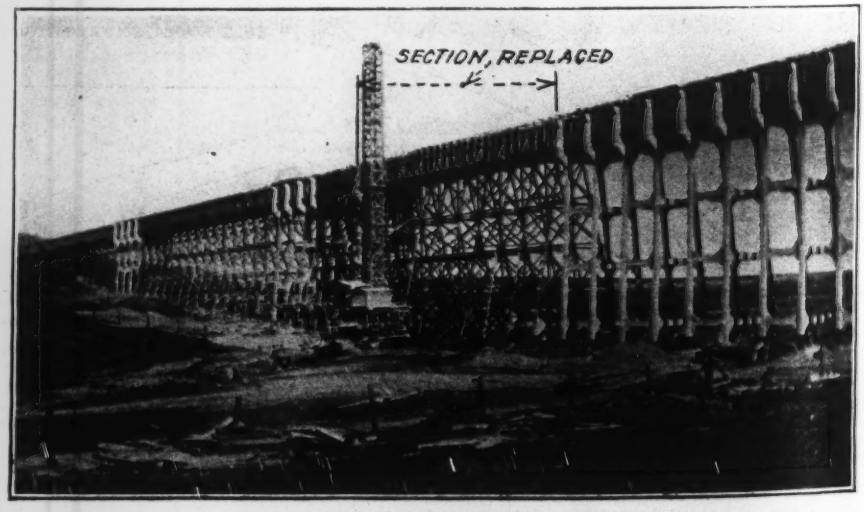
It has been suggested that the staging in the old flume may have increased the area exposed to wind pressure so that with only a light water load the longitudinal bending of the posts at the joints was more than the cross-bracing could withstand. It had been known for some time that the old wood trestle was insecure, however, and the section where the failure occurred was, in fact, under reconstruction at the time, having been selected as the weakest point in the flume.

When the break occurred, 125 sec.-ft. were flowing in the flume, which has a capacity of 1100 sec.-ft. Concrete replacement work was going on directly under the break, and some of the concrete which was still green was carried away by the sections that collapsed. It is notable that the break occurred between two sections of completed concrete towers, or bents, which stood firm under the impact of the water falling 65 ft. almost on the footings. Men were working on the trestle at the time it collapsed, but having the few seconds' warning given by the bending posts they escaped in safety by a narrow margin. The water was turned out of the flume by the dynamiting of a spillway gate above the trestle. At the section where the wood trestle collapsed three concrete towers had just been started, and the fourth had reached a height of about 25 ft. The impact of the falling timbers and water destroyed practically all of the green concrete work. The concrete work on the downstream side of the break had been completed just three days before the break, but it remained intact. Practically all of the members in the timber sections which collapsed were so broken up as to be unfitted for further use.



HIGH WOOD TRESTLE CARRYING FLUME BREAKS CLEAN FROM NEW CONCRETE SECTION

Nine bents spaced 12 ft. c. to c. were required to fill in the gap. The first four of these were framed on the ground in such locations that they needed only to be raised to a vertical position to rest on the concrete footings previously occupied by the bents that collapsed. After these four were in place and cross-braced, the other five were framed one on top of the



WATER WAS FLOWING THROUGH SECTION SEVENTEEN DAYS LATER

other on the ground in the remaining portion of the gap. A-frames were erected in the flume and a cable was strung across the gap. By means of tackle from this cableway, operated by the gasoline engine hoist on the mixer plant, the five bents were then raised to a vertical position one at a time and lashed to the concrete section. The last one was hoisted clear of the ground and shifted along the cableway to its footing 60 ft. downstream. In the same manner the other four were then shifted to their locations, 12 ft. apart.

These temporary bents were designed to permit of being replaced by the concrete supports with the minimum interference. The timber sizes in the temporary bents were the same as those in the original wood structure, except that 8 x 16-in. stringers, 32 ft. long, were put in, and twice the original amount of cross-bracing was used. Altogether, the repair of the break required about 50,000 ft. b.m. of selected pipe and redwood. Water was turned back in the flume 17 days after the day of the break. This time included delay, caused by bad weather, in asphalting and battening the seams. The force consisted of 25 men working 10 hours a day, and the cost of the work was about $4000.

The work has been carried out under the direction of R. W. Olmstead, chief engineer of the South San Joaquin Irrigation District.

Proportioning Concrete by Surface Areas of Aggregates

Tests Tend to Prove Theory that Concrete Strength Depends on Relation of Cement to Total Aggregate Area—Abstract of Paper Before American Society for Testing Materials

VOLUMETRIC proportioning of concrete is notoriously unsatisfactory. Many investigators have been studying other proportioning methods which will at the same time be practical and will insure a maximum strength of concrete with any given material. The latest of such methods and one which in the tests gives promise of some success is that devised by Capt. L. N. Edwards, U.S.E.R., testing engineer of the Department of Works, Toronto, Ontario, which was explained in some detail in a paper entitled "Proportioning the Materials of Mortars and Concrete by Surface Areas of Aggregates," presented to the American Society for Testing Materials at its annual meeting in June.

Briefly, Captain Edwards' principle is that the strength of mortar is primarily dependent upon the

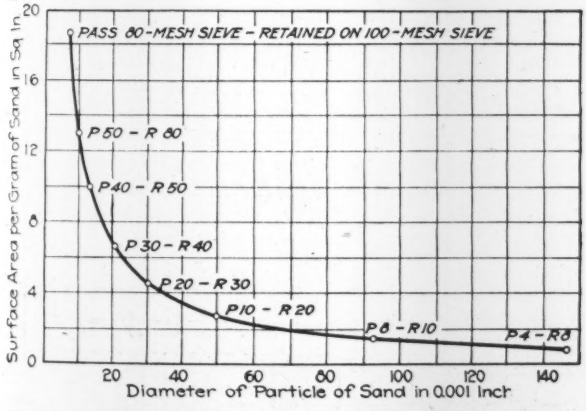


FIG. 1. SURFACE AREAS AND DIAMETERS OF PARTICLES OF SAND GRAINS OF DIFFERENT SIZES

character of the bond existing between the individual particles of the sand aggregate, and that upon the total surface area of these particles depends the quantity of cementing material. Reduced to practical terms, this means that a mixture of mortar for optimum strength is a function of the ratio of the cement content to the total surface area of the aggregate regardless of the volumetric or weight ratios of the two component materials. As a corollary to his investigations, Captain Edwards also lays down the principle that the amount of water required to produce a normal uniform consistency of mortar is a function of the cement and of the surface area of the particles of the sand aggregate to be wetted. Some of the tests deduce the fact, already demonstrated in a number of previous tests, that strength of mortars and concrete is a definite function of the amount of water used in the mix.

In demonstrating the cement-surface area relation, the test procedure was as follows: First, a number of different sands were graded through nine sieves, varying from 4 to 100 meshes per inch, and the material passing one sieve and retained on the next lower was separated into groups. From each group, then, an actual count was made of the average number of par-

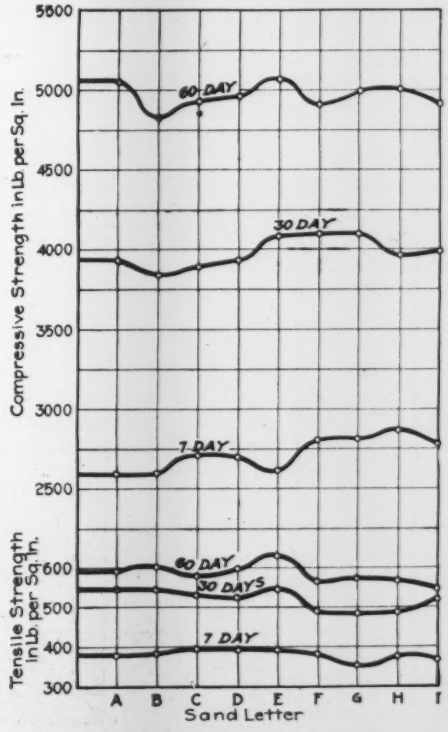


FIG. 2. STRENGTH TEST OF MORTARS OF SAME CEMENT-SURFACE AREA RATIO BUT DIFFERENT VOLUMETRIC PROPORTIONS

ticles of sand per gram. For the larger sizes 8 to 10 grams or more, medium sizes 3 to 5 grams, and for the smallest sizes ¼ to 1 gram were counted. For six sands counted, including a standard Ottawa which is composed of grams passing a 20 and retained on a 30-

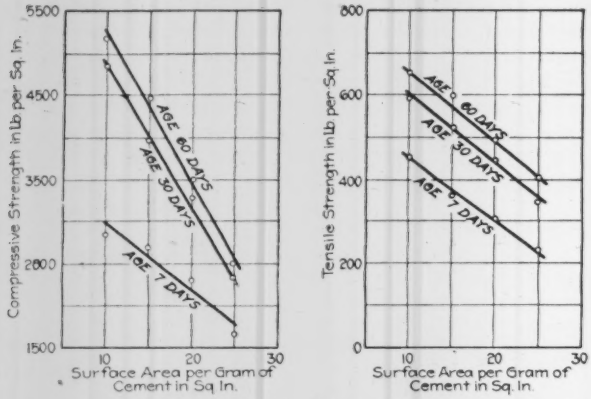

Compressive Strength in Lb per Sq. In.
AGE 60 DAYS
AGE 30 DAYS
AGE 7 DAYS
Surface Area per Gram of Cement in Sq. In.
Tensile Strength in Lb per Sq. In.
AGE 60 DAYS
AGE 30 DAYS
AGE 7 DAYS
Surface Area per Gram of Cement in Sq. In.

FIG. 3. STRENGTH TESTS OF MORTARS OF VARYING CEMENT-SURFACE AREA RATIO BUT SAME SAND

mesh sieve, the following averages were obtained for the number of sand particles per gram:

Passing 4, retained on 8	14
Passing 8, retained on 10	55
Passing 10, retained on 20	350
Passing 20, retained on 30	1,500
Passing 30, retained on 40	4,800
Passing 40, retained on 50	16,000
Passing 50, retained on 80	40,000
Passing 80, retained on 100	99,000

With a specific gravity of sand of 2.689, which had been determined by a number of tests, the average volume per particle of sand was determined for each group, and assuming that the shape of the particles of sand was spherical, which is approximately correct, the surface area per gram of sand was determined for each group. The results are shown in Fig. 1. This gave a basis of surface areas for the various groups of sand in hand.

The sands were then regraded to different granulometric analyses in order to get representative and different kinds of aggregate for the tests. Using these sands for the aggregate, numerous briquets and cylinders were made up and tested in tension and in compression, varying the mix according to the ratio of the weight of cement to the surface area of the sand aggregate. The bases of the ratio of grams of cement to square inches of surface area were 1:10, 1:15, 1:20 and 1:25. The consistency throughout was controlled so that the water content would not affect the relative strengths of the different specimens.

TABLES SHOWING MIXTURES OF TEST MORTARS

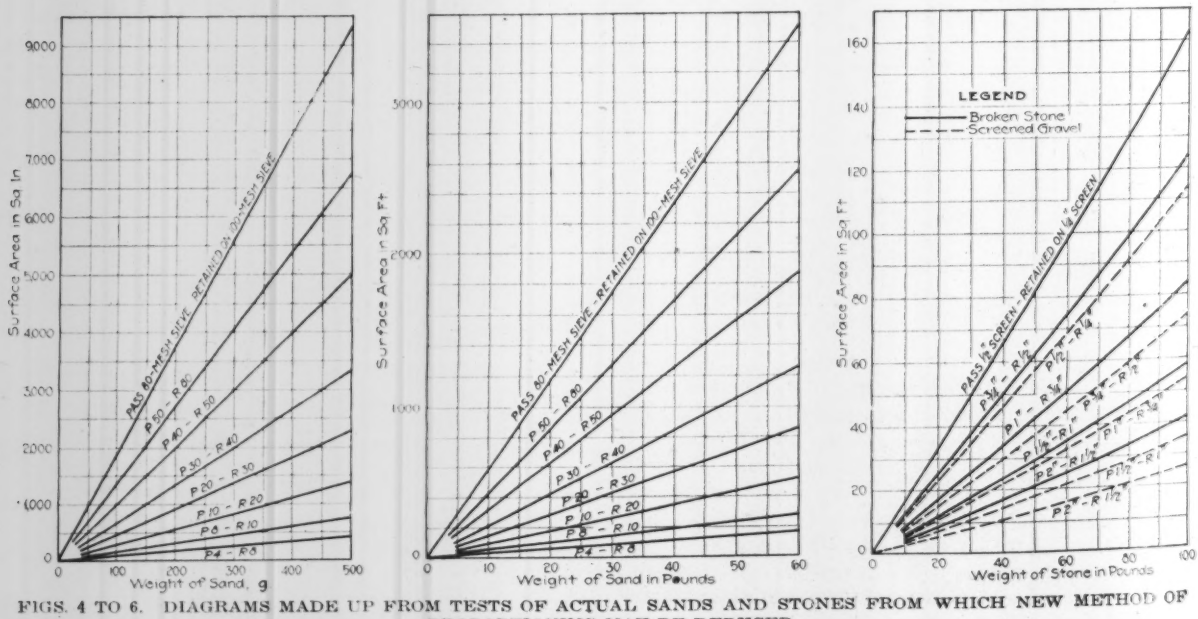
Test Series No. 1. Cement Content—1 G.: 13 Sq.In.

Sand Letter	Surface Area per 1,000 g., Sq.In.	Cement, g.	Water, cc.	Ratio of Cement to Aggregate by Weight
A	5,856.6	450.5	128.0	1:2.22
B	5,106.1	392.0	111.5	1:2.55
C	7,683.7	591.0	134.5	1:1.69
D	6,758.4	520.0	148.0	1:1.92
E	12,816.4	986.0	280.5	1:1.12
F	6,769.1	521.0	148.0	1:1.92
G	4,182.0	321.5	91.5	1:3.11
H	6,564.6	505.0	143.5	1:1.98
I	6,564.6	505.0	143.5	1:1.98

Test Series No. 2. Cement Content—1 G.: 10, 15, 20 and 25 Sq.In.

F	6,769	677.0	183.0	1:1.47
	6,769	451.0	132.5	1:2.21
	6,769	338.5	105.5	1:2.95
	6,769	270.5	92.5	1:3.61

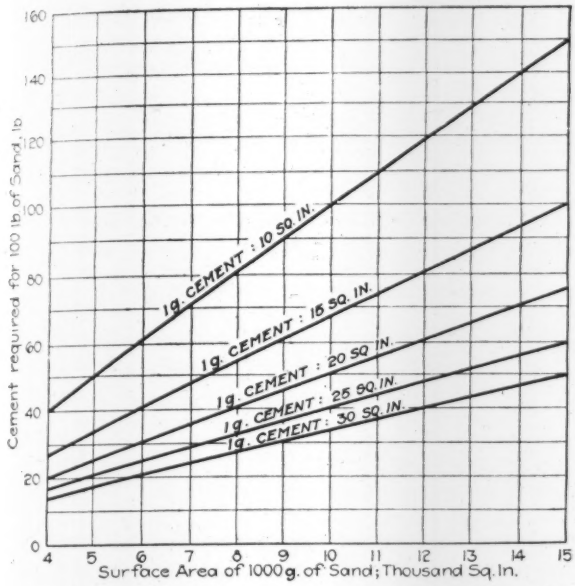
Test mortars were then made, first, by keeping the cement-surface area ratio constant and varying the kinds of sand; second, by varying the ratio and using the same sand. These two series are shown in the accompanying table. As will be noted from the table, in test series No. 1 the cement content is 1 gram per 13 sq.in. of surface area, but the sand has such a different grading and therefore total surface area that the ratio of cement to aggregate by weight varies from 1:1.12 to 1:3.11. In spite of this wide variation in weight and therefore in volumetric relation of the cement to the aggregate, the strength values, as shown in Fig. 2, were markedly constant. In series No. 2 the cement constant varied from 1 gram to 10 sq.in. to 1



FIGS. 4 TO 6. DIAGRAMS MADE UP FROM TESTS OF ACTUAL SANDS AND STONES FROM WHICH NEW METHOD OF PROPORTIONING MAY BE DEDUCED

gram to 25 sq.in. of sand surface, and, as shown in Fig. 3, the strength curves are proportionate to the cement-area ratio.

Further tests were made by Captain Edwards extending this investigation to concrete, and while these


Cement required for 100 lb. of Sand, lb
Surface Area of 1000 g. of Sand; Thousand Sq. In.
1g. CEMENT : 10 SQ. IN.
1g. CEMENT : 15 SQ. IN.
1g. CEMENT : 20 SQ. IN.
1g. CEMENT : 25 SQ. IN.
1g. CEMENT : 30 SQ. IN.

CONVERSION DIAGRAM TO DETERMINE AMOUNT OF CEMENT TO GIVEN SURFACE AREA OF SAND

show the same general results, the tests were not sufficiently elaborate to warrant an abstract of them here.

It might seem offhand that there is no practical application to the method. Certainly, the very considerable labor involved in counting 125,000 sand grains for one sieve group alone would deter anyone from contemplating such a program for practical work, if such a count had to be made very often. However, Captain Edwards points out that this elaborate counting is required only as a preliminary to his method and once done need not be repeated. He says:

"The adaptation of the surface area method of proportioning mortars and concretes to both laboratory investigation and field construction operation presents no serious difficulty. The outstanding feature of this method, in so far as its practical application is concerned, is the importance of knowing the granulometric composition of the aggregate. The securing of this all-important information involves a comparatively small amount of labor and by way of equipment the use of only the necessary scales, standard sieves and screens. The time element involved is comparatively negligible, since the computation work of determining areas and quantities of cement may be largely reduced to the most simple mathematical operation by the use of tables and diagrams."

Diagrams for Laboratory and Field Use

For use in the laboratory and in the field, diagrams drawn to a large scale increase accuracy and reduce labor. Fig. 4 is designed for use in determining the surface area of sand aggregate. It is intended for laboratory use. Fig. 5 is the same sort of diagram intended for both laboratory and field use. The diagrams are derived from information obtained in the tests. Fig. 6 is designed for use in determining the surface of stone aggregate, and is intended for both field and laboratory use, and Fig. 7 shows the conversion diagram for determining the relative quantity of cement in pounds per 100 lb. of sand, and the corresponding relation of cement in grams to the surface area of 1000 grams of sand, and vice versa. The author then gives the following example of how the diagrams shown in Figs. 4-7 may be used:

Example No. 1.—Required to find the composition of a batch of mortar using 1000 g. of sand A and a cement content proportioned: 1 g. cement to 15 sq.in. sand area.

SAND AREA

Sieve	Grading, per Cent.	Weight, g.	Area (Fig. 4), Sq. In.
P 4 – R 8	15.0	150	142
P 8 – R 10	5.0	50	75
P 10 – R 20	25.0	250	694
P 20 – R 30	15.0	150	676
P 30 – R 40	15.0	150	997
P 40 – R 50	10.0	100	992
P 50 – R 80	10.0	100	1,348
P 80 – R 100	5.0	50	932
Totals	100.0	1,000	5,856

$$\text{Cement (g.)} = \frac{5856}{15} = 390.5$$

$$\text{Water (c.c.)} = \left\{390.5 \times 22.25\% \text{ (normal consistency)}\right\} + \frac{5856}{210} = 115$$

The author does not give anywhere what he considers to be the proper ratio of the cement to the sand surface area. That would presumably have to be determined by investigations of the aggregates involved in any case.

Complete Chicago-St. Louis Waterway

IMPROVEMENT of the Illinois & Michigan Canal between Lockport and La Salle, Ill., is now under way, and will provide the missing link in a waterway route between Lake Michigan and the Illinois River. Contracts were let in June for dredging, repair of locks and renewal of aqueducts. Much of this work has already been done, and it is expected that by September water may be turned in the entire length of the canal. West of Ottawa, until further dredging is accomplished, the water depth will be about 4 ft.; through other portions of the canal it will be 6 feet.

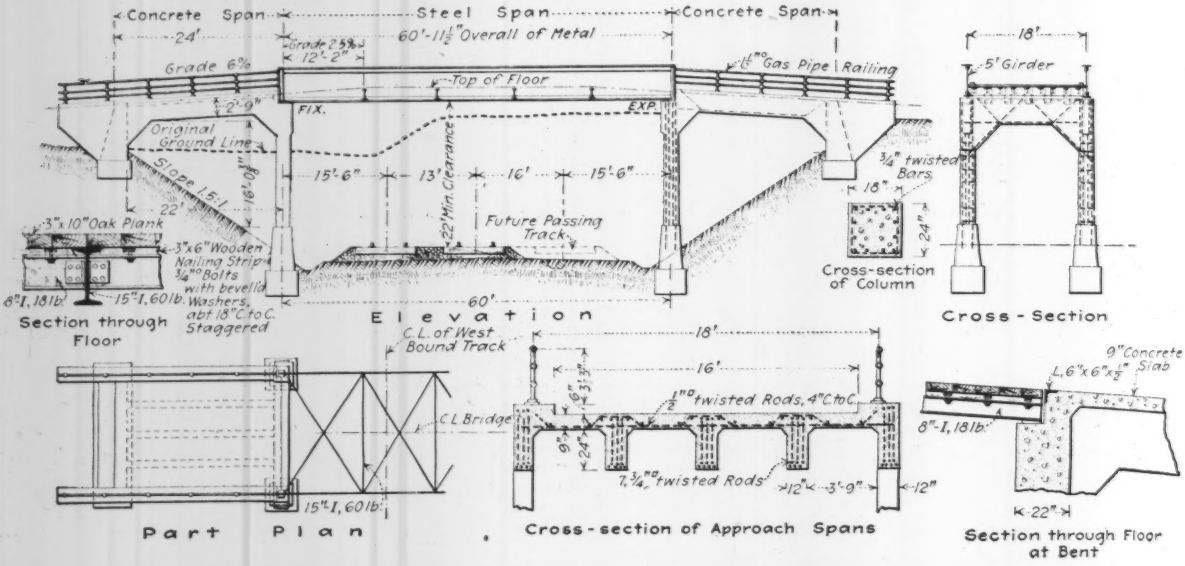
Boats 100 x 16½ ft. can pass the locks and when there is a 6-ft. depth of water the entire length of the canal from Joliet to La Salle boats can navigate with a draft of 4½ ft. A transportation line for the construction of power boats and barges to be operated on this canal has already been organized. The Government is reported to be interested in the construction of barges and power boats for the Illinois River and will probably include some boats of a size to go through the Illinois & Michigan Canal, so that shipments may be made directly between St. Louis and Chicago. From Joliet to Chicago the Chicago Drainage Canal would be used.

For this improvement the United States Government has allotted $150,000. The work is in charge of the United States Engineer Office at Chicago, under Col. C. S. Riché, Corps of Engineers, U.S.A. The Illinois Department of Public Works and Buildings is coöperating, through W. L. Sackett, state superintendent of waterways.

Railroad Utilizes Old Steel Spans in Road Bridges

High Cost and Uncertain Delivery of New Steel Leads to Economical Combination Design—Open Abutments Used

IN BUILDING five highway bridges on the Erie R. R. in Indiana, old steel railway spans were utilized to good advantage. The bridges were built in connection with the double-tracking of that part of the road, described in *Engineering News* of Feb. 8, 1917, p. 224. Four of the five bridges have concrete side spans over the slopes of the cut and one or two steel girder spans over the tracks; the other bridge has two steel lattice truss spans carried by the abutments and a



HIGHWAY OVER CROSSINGS BUILT OF CONCRETE WITH STEEL CENTER SPANS

center pier. Two and three tracks are spanned, and since, in consequence of revision of alignment and grade in double-tracking, the tracks were not in all cases close together or at the same elevation, the structures vary considerably in their span arrangement.

Conditions made it desirable to provide against delays in the construction of the bridges. Two of them were to be put in service shortly after the railway improvement was begun, and the others were required to be ready at fixed later stages of the work, so that prompt delivery of material was essential. Steel was uncertain in delivery and very high in price. Under these circumstances it was found most economical and satisfactory to cut apart and build over for these highway bridges several steel railway bridges which the company had released from its tracks as too light for heavy railway traffic. This bridge material was immediately available and was well adapted for the use made of it.

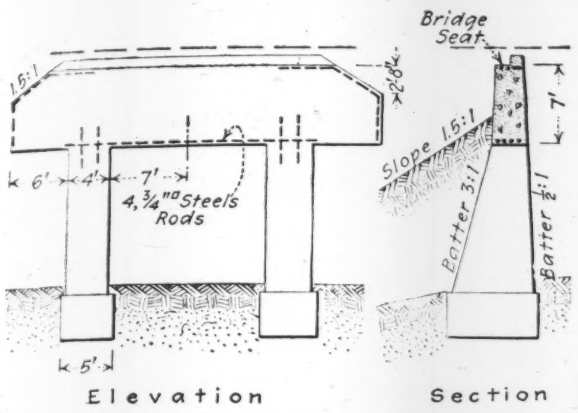
Although the roadbed at all five crossings was in cut, it was necessary to raise the grade of most of the highways on earth approach embankments either side of cut, in order to get 22-ft. railway clearance. To reduce the cost of these fills 6% approach grades were adopted, continuing onto the end spans of the bridges. In some cases transition grades of 2½% were introduced before the level portion of the center of the bridge was reached.

In the steel spans over the tracks the longitudinal girders are spaced 18 ft. on centers except in one case (16 ft.); the clear width between the 6 x 6-in. wheel guards is 2 ft. less. Floorbeams consisting of 15-in. or 12-in. I-beams are riveted between the webs of the girders. Diagonal lateral bracing is provided in each panel.

Timber floors were used on the steel spans, instead of concrete, to save in first cost and in time required for construction, as in some cases the second-hand girders would have had to be reinforced in order to carry concrete floors. When the wooden floors must be removed, they can be replaced with concrete if desired, without loss. No preservative treatment was applied to the wood.

In one span (see drawing) steel stringers were used, on request of the town authorities. Wooden stringers were used in the others, being supported on shelf angles riveted to the webs of the floorbeam webs instead of being set on top, to make the floor as shallow as possible. In all cases the deck is of 3 x 10-in. long-leaf yellow-pine planks. At the ends of the steel spans, the ends of the stringers rest on timbers on the concrete bents or abutments. A sidewalk of 4-ft. clear width is provided at one bridge. To carry it, cantilever brackets are attached to the side of one girder; three lines of 4 x 8-in. wooden stringers support 2 x 8-in. floor plank.

Reinforced-concrete construction is used in the end spans on four of the bridges. It consists of a 9-in. slab on longitudinal beams 12 in. wide and 24 in. deep below the slab. The slab forms the wearing surface of the roadway and was made 1 in. thicker than required by the design, to allow for wear. A hardening liquid was also applied to the surface after the concrete had set. The beams are spaced 4 ft. 3 in. and 4 ft. 9 in. centers. They are reinforced longitudinally with seven ¾-in. square twisted rods. The slab has ½-in.



CONCRETE ABUTMENT HAS BRIDGE SEAT CARRIED ON PIERS EMBEDDED IN APPROACH FILL

square twisted rods spaced 4-in. centers transversely, and a few longitudinal rods to provide for temperature stresses only.

Concrete bents at the foot of the railway-cut slopes carry the spans. A typical bent, as in the bridge illustrated, has two columns each 18 x 24 in. and a concrete cross-girder 22 in. thick by 6 ft. 3 in. deep. Substantial concrete brackets are provided on the columns under the cross-girder and the outer longitudinal beams of the end span. The end of the concrete roadway adjoining the wooden floor of the steel spans is protected by a steel angle anchored by bent bolts.

Railings of 1½-in. gas pipe guard the side of the roadway, except where the longitudinal girders project 39 in. or more above the road surface.

At two of the bridges, where the tracks crossed are at different grades and considerably separated, each track is bridged with a separate span, the adjacent ends of these being supported on two square piers having a height of 37 ft. The other ends of the spans are supported on concrete abutments.

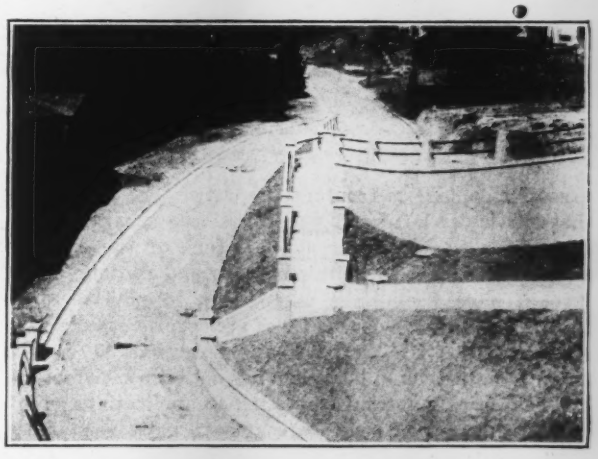
Abutments of an unusual form are used—open type, illustrated by sketch herewith. The type is standard on the Erie for use in highway bridges where the height from the roadway to the top of the original ground level at the face of the abutment is greater than 10 ft. The abutment consists of two or more piers built up to within about 8 ft. of the roadway and a reinforced-concrete capping beam which is anchored to the piers with steel rods. As the fill for the highway approach is made it runs under the beam and buries the piers. Considerable saving over the solid type of abutment is accomplished, under favorable conditions.

In the bridges described, 1:2:4 mix was used for reinforced concrete and 1:2½:5 for plain concrete. The columns and cross-girder of a bent were concreted in one operation, up to the underside of the concrete stringers, and the entire floor of the end span was placed in another operation. Care was taken to get a good surface and finish on the concrete and a good cover of concrete over the rods in the top of the floor slab.

While the designs were worked out for a live load, including a 12-ton road roller, and a distributed loading of 100 lb. per square foot, the bridges will carry 20-ton rollers with safety and thus should prove adequate for all probable traffic demands. They were designed by F. A. Howard, engineer of bridges. The work was under the general direction of R. S. Parsons, chief engineer, and R. C. Falconer, assistant chief engineer, of the Erie R.R. The concrete work was done by the Robert Grace Contracting Co., of Pittsburgh, Penn., and the steel spans were remodeled and installed by the railway company's forces.

Reduce Grades By Spiral Development of Hillside Streets

A SPIRAL street layout which is composed of curves and inclines, as shown in the accompanying drawing and view, avoids excessive grades in a steep hillside residence district of Berkeley, Cal. The 16-ft. roadway is partly in cut and partly on fill, the latter being supported by concrete retaining walls. At the top and bottom turns the width was increased to 25 ft. and 20 ft. respectively, and an outside radius of 20 ft. was used at the top, while 21½ ft. was used at

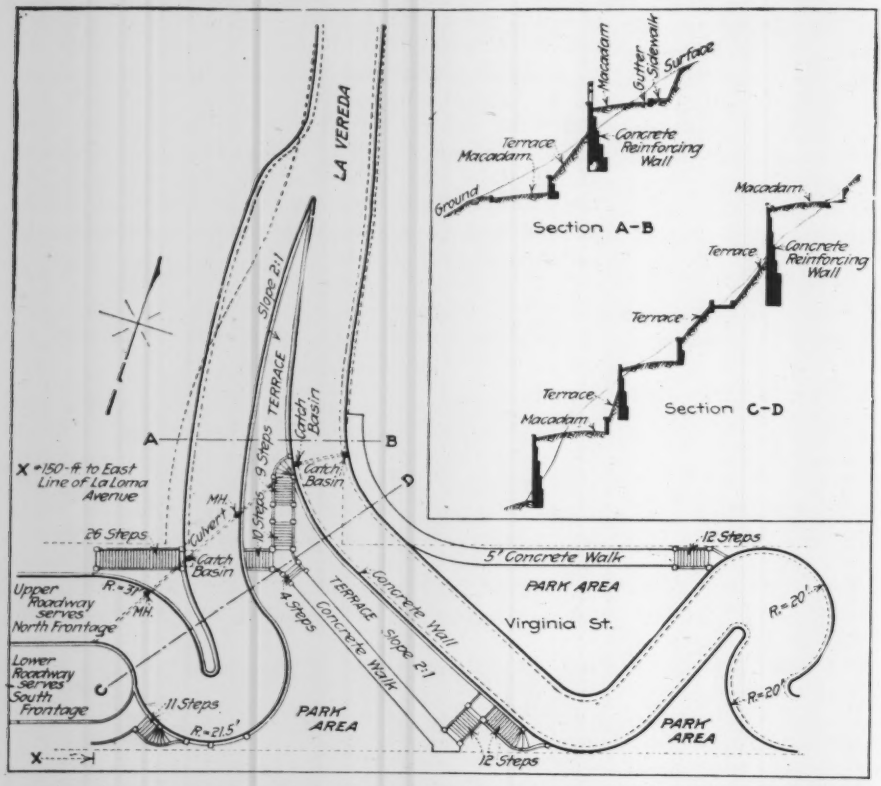


ROADWAY AND SIDEWALKS ARE SEPARATED IN HILLSIDE LAYOUT

the bottom. Each of these turns covers an angle of more than 200 degrees.

An independent and more direct location is used for the 5 ft. sidewalk, the steeper grades thus resulting being overcome in part by stairways. The steps are of 7-in. rise and 11-in. tread, except that those on the turns have a rise of only 6 in. The whole layout is treated in a decorative manner, with concrete parapets and curb walls, and parked or terraced slopes. Drainage is taken care of by concrete gutters, intercepted at five points by catchbasins opening into a pipe culvert which crosses the street layout diagonally.

As Berkeley is built on the abrupt foothills of the Coast Range, it has a variation of about 1000 ft. in elevation, 700 ft. of this being in the eastern ½-mile width. Originally, this district was cut through by numerous ravines, so that in laying out the streets many special treatments and methods have been employed in order to secure adequate facilities without



SPIRAL LAYOUT OF STREET AVOIDS HEAVY GRADES IN HILLSIDE DISTRICT

excessive damage to frontage property. The plan shows that the lower left-hand street has two separate roadways to serve the different elevations of the opposite sides of the street. Split roadways and contour street layouts have been used extensively to obviate steep grades, but in spite of this there are several streets with grades of 10 to 15% and a few of more than 20%. The original water-bound macadam has not been satisfactory, but has been maintained by surface applications of oil and screenings. Recent experiments have been made with concrete and brick, with the results favoring the latter where grades are more than 8 to 10%. The information in regard to these exceptional conditions of street layout and paving was furnished by C. C. Kennedy, city engineer.

Better Operators for Water and Sewage Treatment Plants

New Jersey Law Provides for Examination and Licensing Under Direction of State Department of Health

THE legislature of the State of New Jersey has passed and the Governor has signed a bill which provides that hereafter all water-purification plants and all sewage-treatment plants in the state must be in charge of superintendents or operators who hold licenses granted under the direction of the State Department of Health. On its introduction in the legislature the bill was accompanied by a statement of its purpose which is well worth quoting, as follows: "The purpose of this bill is to secure the employment of attendants at water-purification and sewage-treatment plants having a higher degree of intelligence and more familiarity with the operation of these plants than is now the case. There are a large number of water-purification plants and sewage-disposal plants now in operation in this state. The experience of the State Department of Health has shown that many of these plants, particularly the smaller ones, are operated in a very unsatisfactory manner. This results, in the case of water-purification plants, in imperfect purification of the water at times, and the consequent exposure of the people who use the water to danger from water-borne diseases. In the case of sewage-treatment plants not properly operated, the streams into which effluents from these plants are discharged are polluted, in some cases to the extent of causing gross nuisances. The unskillful and careless operation of these plants also results in their rapid deterioration, which ultimately entails upon the municipalities owning them the expenditure of funds for repairs and replacements which would not be necessary were the plants properly operated."

As this bill appears to be pioneer legislation, the body of it is given in full:

"1. In order that municipalities, corporations or individuals owning or operating water-purification or sewage-disposal plants may secure the services of capable superintendents or operators, the Department of Health of the State of New Jersey is hereby authorized to cause examinations to be made, by such persons and at such times and places as it may appoint and under such rules and regulations as it may adopt, for the purpose of determining the qualifications of applicants for licenses as superintendents or operators in charge of any water-purification or treatment plants purifying or treating water used for potable purposes by this state or of any sewage-treatment plants discharging an effluent into any of the waters of this state. Every such examination shall be in such subjects and conducted in such a manner as the Department of Health of the State of New Jersey shall direct, and every applicant whose examination shall be approved by said department shall receive a license as superintendent or operator of public water-treatment plants or public sewage-treatment plants, as the case may be.

"2. No municipality, corporation or individual shall appoint any person as superintendent or operator in charge of any water purification or treatment plant

purifying or treating water used for potable purposes by inhabitants of this state or of any sewage-treatment plant discharging an effluent into any of the waters of this state, or permit any person to discharge the duties of superintendent or operator in charge of such plant who is not the holder of a license issued by the Department of Health of the State of New Jersey under the provisions of this act; *provided, however*, that nothing herein contained shall prevent any municipality, corporation or individual from continuing in office any person now occupying the office of superintendent or operator in charge of any water-purification or treatment plant or any sewage-treatment plant, and the Department of Health of the State of New Jersey, upon certification from the proper municipal officer, corporation or individual, that such person held the office of superintendent or operator in charge of such water-purification or sewage-treatment plant at the time this act became effective, shall issue a license to said person in the same manner as if he had passed an examination held by the aforesaid department.

"3. The Department of Health of the State of New Jersey may revoke the license of any superintendent or operator in charge of any water-treatment or sewage-treatment plant if, after a hearing held by said department at which said superintendent or operator shall have had an opportunity to be heard, either in person or by counsel, said department shall determine that the said superintendent or operator in charge is incompetent to manage said plant, or that he has wilfully neglected his duty in supervising the operation of said plant, or that he has disregarded or disobeyed the lawful orders, rules or regulations of said department."

Violators of the act are liable to a penalty of $10 per day, to be recovered in an action of debt by the State Department of Health. The department is authorized also to apply to the Court of Chancery for an injunction to restrain any violation of the act.

Engineers Advocate Hard Paving on Steep-Grade Streets

Practice in Several Cities Throughout the United States To Use Stone, Brick and Concrete Either for Full Width or for Strips in Combination with Asphalt

HARD-SURFACED pavements such as concrete, grouted stone block and brick are preferred by engineers for use on steep grades, while macadam, which heretofore has been used so extensively, is rapidly being discarded. This appears to be the conclusion to be drawn from an inquiry made in several cities as to their practice in paving steep grades. The fact that horse-drawn traffic is rapidly being replaced with motors is given as a reason for changing from the old methods.

The inquiry indicated that the engineers consider the design of paving for steep streets a special problem, involving the combination of efficiency with safety. With horse traction, a rough surface and open joints were essential to afford a foothold. With motor vehicles, however, open joints are not necessary, and the main point is to avoid slipperiness of the surface while affording sufficient grip for traction and braking. The minimum grade which may be called steep seems to be about 5 or 6%. The maximum reported is 50.1%, but grades of 10% to 20% are found in a number of cities. That various combinations of construction are being adopted to meet local conditions of grade, traffic and available material is also shown. A review of the information gathered is given in the following pages.

LAYING CENTRAL STRIP OF BRICK ON STEEP GRADE AT SAN FRANCISCO, SIDE STRIPS TO BE OF ASPHALT

Cobblestone paving on a grade of 50.1%, vitrified brick on 26.2% and a limit of 18% for asphalt when used as a side strip, are illustrative of steep-grade paving conditions in San Francisco. Until a few years ago the standard construction of grades of more than 20% consisted of cobblestones set upright on a sand bed, having the joints filled with gravel. This afforded good foothold for horses, but was unsightly. As automobiles and motor delivery wagons replaced horse traffic, there came a demand from property owners and tradesmen for a more modern type of paving.

Limiting grades for different paving materials have been established by ordinance as follows: Asphalt up to 6% within the heavy teaming district, and 8% in other parts of the city. Where a central strip of block paving is prescribed, the asphalt limit is extended to 18 per cent. For basalt block and the various types of vitrified brick paving, no grade limits have been established. From experience with paving on steep grades, and taking into account the question of cost, availability and present traffic requirements, the following six types have been adopted as the most satisfactory: Basalt blocks on concrete; basalt block central strip with asphalt side strips; basalt block side strips with central strip of asphalt; standard vitrified brick, hillside style, on concrete; rough kiln-marked brick, local type, on concrete; vertical-fiber brick on concrete, of modified monolithic type.

"We have full confidence in the basalt and standard vitrified brick types," says James M. Owens, assistant engineer in the Department of Public Works, "but do not consider that the limited time the other types have been down entitles them to the same consideration. A service test of proper length will be necessary to decide their fitness. However, so far they have stood up remarkably well, have given no signs of failure and apparently will work out satisfactorily."

Basalt-block paving is built under specifications which require a 6-in. concrete base and a 2-in. sand cushion. Blocks are 3½ to 4 in. wide, 7 to 9 in. long and 6 to 6½ in. deep, with no projections exceeding ¼ inch. They are matched so as to have those of the same width in a row. The joints are ½ to ¾ in. wide and before the paving is rammed they are partly filled with gravel of sizes from ½ in. to $\frac{3}{16}$ in. After the ramming is done, the joints are filled with gravel to within 1 in. of the surface, and then finished with 1:2 cement grout mixed to the consistency of thin cream. As soon as this is stiff enough not to flow, it is swept out to a depth of 1 in., and the joints are filled to the top with gravel.

Vitrified-brick paving is built to specifications requiring a 4- or 6-in. concrete base with a 1½-in. sand cushion and 1:1½ cement grout filler. For grades of more than 6% and where machine-mixed concrete is used, the thickness may be 4 in., and the bricks must be rough and irregular on the exposed surface.

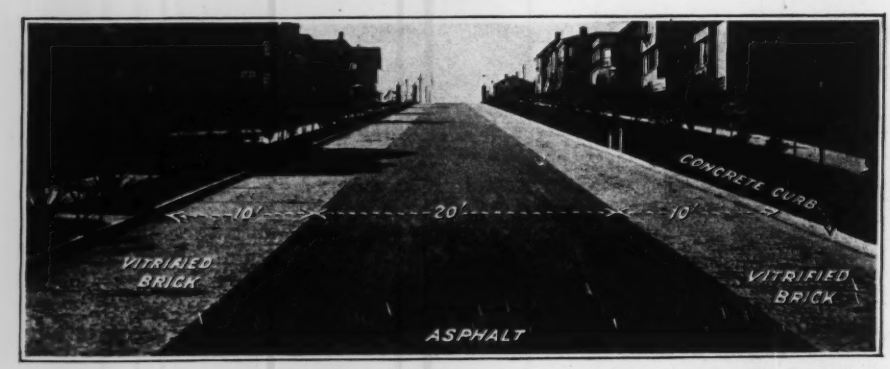
St. Paul Experiments with Wood and Concrete

Sandstone block and vitrified brick paving have given successful results in St. Paul, Minn., but during 1917 experimental work with concrete and wood block for paving grades was inaugurated. One-course concrete was laid on a 7% grade on Mounds Boulevard. Creosoted wood-block paving, with courses separated by transverse strips and the open joints filled with pitch, was laid on a 6% grade on the Summit Ave. approach to the Mississippi River boulevard. Creosoted wood block with lugs was laid on a 3% grade on Minnesota St. in the heart of the business district.

Flattening the crown of streets on grades, so that on very steep grades the crown is almost imperceptible, is practiced in St. Paul with various kinds of paving. Thus, the storm water is carried in a thin sheet over the surface of the pavement, instead of being diverted quickly to the sides and thereby flooding the gutters.

Rules adopted during recent years by Oscar Claussen, city engineer, provide for creosoted wood block on grades not exceeding 2½%, and sheet asphalt or asphaltic concrete on grades not exceeding 5% or preferably 4 per cent. For grades of more than 2½%, in streets having wood-block paving, either sandstone or brick is used, with preference for the former when the grade is 6% and more. On streets having sheet asphalt or asphaltic concrete, brick would be recommended for grades of 4 to 6 per cent. It is stated that the sandstone blocks are not slippery and make an excellent pavement on grades of 6% and more.

Sandstone block is used on steep grades in Denver, Colo., being laid for the entire width of the roadway on streets in the business district, and for an 8-ft. strip on the ascending side of asphalt-paved streets in the residence districts. As described by H. F. Meryweather, chief assistant engineer in the Department of Improvements and Parks, the blocks are laid on a concrete base and give an even and regular surface over which loaded wagons may be easily drawn. At Duluth, Minn., sandstone blocks have proved the most serviceable and satisfactory paving for steep grades. The city engineer, Lyonel Ayres, states that the gritty quality of the stone prevents it from becoming slippery, and the uneven surface enables the horses to get a good foothold. The foothold is assisted also by using sand filler, as grout filler makes the pavement too smooth. For a width of 4 ft. to 5 ft. at each curb, however, at 1:2 cement grout is used to form a surface for carrying storm water.



COMBINATION ASPHALT AND BRICK PAVING ON SAN FRANCISCO STEEP GRADE

Granite block and vitrified brick are used on steep grades in Louisville, Ky., the former use of water-bound macadam having been abandoned. Cement filler is advisable for permanence of brick paving, but if this is filled flush with the top of the brick on grades of more than 5% the surface becomes too slippery for ordinary horse-drawn traffic. On grades of 5 to 8%, therefore, the filler is brushed out of the joints so as to be about ⅛ to ¼ in. below the top of the bricks. Special "hillside" brick is used on grades of more than 8 per cent.

The modern type of monolithic brick paving is preferred in Berkeley, Cal., after two years' experience with brick and concrete, as shown by the following statement from C. C. Kennedy, city engineer:

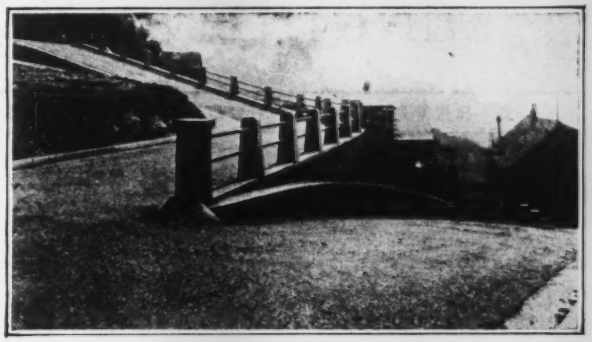
"From an experience of the past two years, taking into consideration the questions of ease of manipulation in construction, freedom from slipperiness and appearance, I consider that brick of the monolithic type of construction, using vertical-fiber brick burned on edge and laid flat so that a minimum of variation exists, represents the most desirable construction for hillside streets with grades in excess of 8 or 10 per cent."

Numerous streets have grades of 10 to 15%, and a few in excess of 20 per cent. These were paved originally with water-bound macadam, like the other streets, but they eroded during the winter rains and raveled under traffic during the dry summer season. Surfacing with a mat of asphaltic oil and screenings was tried about 10 years ago, but while it remedied these troubles, it made the surface smooth and slippery. On curves the mat could not resist the shear, so that corrugations developed, particularly with the rapid increase of motor traffic. However, by scarifying, reshaping, light re-oiling and rescreening these surfaces, it has been possible to utilize the full wearing life of the street material.

Reconstruction of the oldest of the hillside streets was done in 1916 and 1917. For the first part of the work reinforced concrete was used, with slabs about 20 ft. square and having corrugated surfaces for grades in excess of 12 per cent. In 1917, monolithic brick paving was laid, using hillside brick on a 4-in. base of 1:3:6 concrete with a 1:3 surfacing mixture ½ in. thick placed on the fresh concrete. For the 1918 work, the same type of construction has been adopted, but with 2½-in. vertical-fiber brick on a 4-in. base, making a total thickness of 6½ inches.

Concrete paving is used with satisfactory results on grades as steep as 16% at Sioux City, Iowa. When this paving began to be used in 1911, there was an impression that it would be slippery, and on grades of more than 5% corrugations were formed in the surface to give a foothold. It soon became apparent that these were of no assistance to traffic and formed an element of weakness in the pavement. In subsequent work, therefore, they were omitted.

While concrete may be slippery if finished with a smooth float when there is an excess of water, it is the opinion of T. H. Johnson, city engineer, that a surface affording a good foothold can be obtained readily. This is accomplished by finishing with a heavy wood float until the surface mortar becomes sticky and adheres to the float. This leaves the surface with the desired roughness, but at the same time with all pores properly sealed. For the latter reason, this method is considered



MACADAM ROADWAY ON STEEP STREET AT BERKELEY, CALIFORNIA, SURFACED WITH OIL AND SCREENINGS

superior to brooming, which ruptures the surface, making it sharp and subject to abrasion readily.

Concrete for grades up to 10% on country roads, where the traffic consists largely of heavy motor trucks, is advocated by H. Eltinge Breed, first deputy commissioner of the New York State Commission of Highways. He considers that, if well constructed, concrete will be less slippery than bituminous macadam, oiled water-bound macadam or brick (except hillside brick), and not more slippery than open-joint granite-block paving. Care must be taken, however, to use proper aggregate and proper finish.

The concrete should be fairly dry and receive as little screeding as possible to avoid bringing the finer material to the surface. He favors brooming the surface, giving a roughness which will last for awhile. Results from scoring or marking the surface have not been found worth the cost of such treatment. Expansion joints should be perpendicular to the surface, with the expansion strip kept about ½ in. below the top, so that the concrete may be floated over it and make a smooth surface. When cracks appear at these joints they can be filled with tar and sand. To prevent the slabs from creeping downhill, Mr. Breed is experimenting with a curtain wall or stop across the down-hill end of the slab. This is 9 in. wide and extends 12 in. below the bottom of the slab.

Concrete paving on streets having grades of 8 to 29% is noted by the Portland Cement Association. Some of the examples are as follows: 29% on Baxter St., Los Angeles, Cal.; 22% on East Mercer St., Seattle, Wash.; 18% on 23rd St., Kansas City, Mo.; 16% on Pearl St., Sioux City, Iowa, and 15% in Milwaukee, Wisconsin.

Combinations of two materials on steep streets have been employed in some cases, as noted above. Asphalt-paved streets at Denver, Colo., have an 8-ft. strip of sandstone blocks next to the curb on the ascending side. In San Francisco the combination paving includes 20 ft. of asphalt flanked on each side by 10 ft. of vitrified brick; 14 ft. of basalt block or monolithic vertical-fiber brick flanked by 12½ ft. of asphalt.

At Sioux City, Iowa, the combination paving laid for the benefit of traffic was not appreciated by the drivers. Some years ago asphalt-paved streets, on grades of about 10%, were made with a 10-ft. strip of brick paving on each side, to afford a good surface when the asphalt was slippery. According to T. H. Johnson, city engineer, the traffic did not use these strips, and the practice was not continued.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Some Broad Features of Flood Relief

REVIEWED BY ROBERT E. HORTON
Consulting Hydraulic Engineer, Albany, N. Y.

RELIEF FROM FLOODS: The Fundamentals of Flood Prevention, Flood Protection and the Means for Determining Proper Remedies—By John W. Alvord and Charles B. Burdick, Members Am. Soc. C. E., Chief Engineers, Franklin County Conservancy District, Consulting Hydraulic Engineers. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 169; illustrated. $2.

This is not a complete treatise on floods, much as a comprehensive work on this subject is needed, nor does it even cover completely the subject of flood relief. The purpose, as stated in the preface, has been "to outline briefly the general flood problem in all its many phases, to show what remedies can be applied and to point out the way to the selection of proper works." For the most part it is of the nature of an essay, touching briefly on the broad features of flood relief. In places it goes considerably farther, giving fragments of technical data and methods which would properly form the nucleus of a treatise on floods and flood relief. The book is not highly technical, neither can it be called popular in the ordinary sense. It contains a number of tables useful to the consulting engineer and designer, but much of the descriptive text and most of the illustrations seem better calculated for use in the promulgation of flood relief propaganda.

While the reviewer feels—and no doubt the reader will feel—that the book is somewhat sketchy, yet it is a book that will broaden the mind of the business man who lives in a flood-menaced region and probably also that of the average engineer who has not specialized in the peculiarly difficult problems of hydrology, particularly those in relation to floods.

Chapter III relates to flood investigations and includes among other things concise, well phrased remarks on the psychology of technical reports. These remarks, while pertinent to flood investigations, apply with equal force to every project in which the engineer is called upon to advise the public. This and the paragraph on "Conservation" are eloquent sermons on professional practice which engineers, old and young, will do well to read and reread. The futility of half-way measures or partial flood protection is strongly emphasized—too strongly, it seems, since the extent to which the public can afford to go to safeguard itself completely against the rarest flood calamities is an open question, to be solved on its merits in each case. The authors have not drawn clearly enough the distinction between partial flood protection works on the one hand, such as the old Dayton levees, that are ordinarily beneficial, and yet may aggravate a rare maximum flood; and those, on the other hand, such as reservoirs, which are nearly always beneficial so far as they go.

In Chapter IV the various classes of investigation needed as a basis of flood reports are concisely outlined, including the important subject of ex post facto determinations of flood discharge. Here again the discussion seems too concise; elaboration and detail would have greatly enhanced the value of the subject matter. Methods of gathering records of flood heights on a stream undergoing investigation are further discussed in Chapter V, but very little is given with reference to the utilization of such data.

In Chapters III and V and elsewhere appears discussion of the related questions whether flood magnitudes are increasing or not, and what is the greatest flood magnitude to be expected on a given stream in the future. The psychology of the popular belief that floods are increasing is well explained. The danger of basing conclusions on records of short duration is pointed out, the value of continued stream flow records is emphasized, and a few examples are cited to illustrate the point that floods as great as those of recent years have occurred as far back as records are available.

In Chapter V, under the heading "Fundamental Data," the subject of rain intensities receives a scant five pages of discussion. The authors seem rather to disparage the utility of rainfall data in flood studies.

While it is properly pointed out that estimates of flood volumes based on gagings or flood heights are usually to be preferred to those based on rainfall alone, yet it often happens that the latter have to be mainly depended upon. Recent well authenticated maximum flood heights are often not as readily available as they have been in connection with the studies made by the authors in the Ohio flood district. Furthermore, in determining the probable frequency and magnitude of future floods to be provided for, rainfall records are commonly available, running back much farther than records of stream flow or flood heights, and since for the solution of that problem duration of records is of primary importance, as the authors have pointed out, it appears that the use of rainfall records and especially of rain intensity records in that connection is worthy of much more inclusive treatment than it has received.

The subject of economics of flood protection works is briefly treated, but the relation of frequency of occurrence of excessive floods to the justifiable expenditure for flood relief is barely mentioned. In fact, the matter of determining flood frequency is kept in such shape that the reader remains in doubt as to how much may be accomplished along this line and how the results should be applied.

No doubt there has been a tendency in the estimation of flood discharges to use ready-to-hand general formulas as a basis of conclusions as to maximum floods and flood frequencies, rather than to carry out the far more laborious operation of compiling and analyzing the most complete data obtainable for the stream in question. The authors seem not to have gone as far as they should in emphasizing the fundamental principle of hydrologic work, namely, that one should make the best possible use of all the available information, and that, in general

an ounce of actual data is worth a pound of inference.

Subsequent chapters relate to different methods of flood prevention and flood control, and the broader features of channel improvements, storage and detention reservoirs are well covered. The examples and illustrations are mainly drawn from reports on the Ohio floods of 1913.

An appendix contains an excellent table of maximum flood discharges on about 120 streams for which there are continuous records for 10 years or more. The date and magnitude of the maximum flood and its relation to the average flood is given in such form as to be generally more useful than similar tables heretofore available.

The perfect book on an engineering subject has not yet been written, and in spite of the apparent sins of omission, the authors have produced a book which provides useful material for thought even to those best informed on the subject treated.

Bridge-Column Tests Finally Published

TESTS OF LARGE BRIDGE COLUMNS—By J. H. Griffith, Associate Engineer Physicist, and J. G. Bragg, Assistant Physicist, Bureau of Standards. Technological Paper No. 101. Washington, D. C.: U. S. Bureau of Standards. Paper; 7 x 10 in.; pp. 139; illustrated. 30c. from Superintendent of Documents, Washington, D. C.

Four years' waiting for a report on the tests of large bridge struts carried out by the Bureau of Standards is rewarded now by a full and well-argued presentation of the results. The struts were replicas of members of the new Memphis bridge, the Metropolis bridge, and the St. Louis Municipal bridge; cross-sectional areas from 42 to 119 sq.in. were represented. The objects of test were built of various high-strength steels, and most of the ultimate loads realized were above 40,000 lb. per square inch.

Attention is directed to the fact that one set of columns in particular failed throughout in smooth curves, proving integrity of action of the riveted assemblage in high degree. All the test members were open-section riveted structures, about half of them being fitted with continuous longitudinal diaphragms. For this reason, and because of the fact that one end of each column bore on a pin, a large amount of highly valuable detail information is contained in the test records.

Interpretation of such complex tests necessarily involves so much personal judgment that the document bears the character of a technical article rather than that of a mere matter-of-fact report on observed phenomena. Correspondingly, the bridge engineer in reading through its 139 pages will need to apply his own analysis to the test figures and the reported behavior of the columns, and he is likely to be led to views diverging from those of the authors, in more than one detail.

In welcoming a report of the excellence of this one, every engineer will be impressed with the fact that so long a delay in publication as four years is unfortunate. Data of great importance to professional men all over the country should be laid before them with the utmost promptness. However, since the attention of the bureau has for more than a year been almost wholly taken up by war work, it is not hard to understand that many things delayed getting the report into print.

Special credit is due the authors for their painstaking study of column action in connection with the analysis of the test results.

Resolving Power of Small Telescopes

TESTS OF SMALL TELESCOPES AT THE LABORATORY OF THE DOMINION LANDS SURVEYS—By E. Deville, Surveyor General of Dominion Lands. Bulletin 41, Topographic Surveys Branch, Department of the Interior, Canada. Ottawa, Ont.: Address the Deparment. Paper; 6 x 10 in.; pp. 20; illustrated.

A fundamental question for every user of transit or level is discussed in this pamphlet. Telescope quality is of exceptional importance in the Dominion land survey work because daytime star observations must be made, and stadia measurements are made at distances up to one-half mile with rods divided to tenths of links or about $\frac{3}{4}$ in. Resolving power of the telescope is a critical feature in such work. It was studied by laboratory work conducted by W. C. Way, and enough was learned, as set forth in the present pamphlet, to give the surveyor direct guidance in the choice of telescope characteristics for a given class of work. One remarkable fact, determined by special measurements, is that in close-range work and at very low magnifications the resolving power is likely to exceed the magnification by amounts varying up to 10% as maximum. Certain phenomena also led to the conclusion—not fully verified by experiment—that the eye is keener when looking at an image through an ocular than when looking at the object itself with the naked eye. It developed also that an objective had one-fourth greater resolving power photographically than visually.

Recommendations based on the experiments are so framed as to carry out the principle, "The best size for a surveyor's telescope is the smallest that will just meet his requirements." It is shown that the same resolving power can be had with telescopes of different sizes—magnification and brightness varying at the same time, of course. Formulas given enable the required resolving power for such reading as is done in leveling to be computed from distance and rod interval.

Studies of Municipal Problems

A new series of publications designed to aid officials and employees of the City of New York has been started by the Municipal Reference Library of the city named. The first of these, by Dorsey W. Hyde, Jr., librarian, is entitled "What to Read on New York City Government" (5 cents) and contains a list of references to pertinent books, pamphlets and periodicals.

Vibration Measurements in High Chimney

In Japan earthquakes are fairly common and precautions must be taken in design to care for the stresses induced by movement of what should be terra firma. As a part of the study of such stresses, Dr. F. Omori, the well-known Japanese earthquake expert, has made a number of measurements of the movements of high reinforced-concrete chimneys, particularly of the record Saganoseki chimney, which is 567 ft. high. These measurements and their importance to earthquake-re-

sisting design are made the subject of a paper by Dr. Omori, published in English by the Imperial Earthquake Investigation Committee, as Vol. IX, No. 1 of its bulletins. Presumably, copies may be obtained by writing the committee at Tokyo.

Change of Name and Size

Highway Transportation is the new name adopted for the *Motor Truck Club Bulletin*, which is the official organ of the Motor Truck Club of America, Inc. Coincident with the change in name, the size and the number of pages have been increased. The July issue contains reading matter of interest to all those concerned with motor trucks or motor truck transportation. The Journal is published monthly from the offices of the club, 1790 Broadway, New York City. Theodore D. Pratt, executive secretary of the club, is editor.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other persons indicated.]

ANALYSIS OF MINE AND CAR SAMPLES OF COAL COLLECTED 1913 to 1916—Washington, D. C.: U. S. Bureau of Mines. Paper; 6 x 9 in.; pp. 478; mostly tables.

CALENDAR OF LEADING EXPERIMENTS—By Wm. S. Franklin and Barry MacNutt. South Bethlehem, Penn.: Franklin, MacNutt & Charles. Cloth; 6 x 9 in.; pp. 210, illustrated. $2.50 postpaid.

Deals primarily with lecture demonstrations in physics. Contains many allusions to engineering and much to stimulate thought by thoughtful engineers. Sharply personal in the views expressed, and in large part polemic in character as much as didactic. What the authors have to say on instruction in Mechanics is of direct importance to engineering teachers.

CONCRETE COTTAGES: Small Garages and Farm Buildings—Edited By Albert Lakeman, M.S.A., M.G.I., Honours Medallist Construction. London: The Concrete Utilities Bureau. Cloth; 6 x 9 in.; pp. 170; illustrated. 5 shillings net.

THE DIFFUSION OF OXYGEN THROUGH STORED COAL—By S. H. Katz. Washington, D. C.: U. S. Bureau of Mines. Paper; 6 x 9 in.; pp. 47; illustrated.

Gives results of part of an extended study "of the conditions affecting deterioration and spontaneous combustion of stored coal." Effects of sizes of coal and percentage of voids are considered.

FOREIGN COMMERCE AND NAVIGATION OF THE UNITED STATES, 1917—Washington, D. C.: Superintendent of Documents. Cloth; 9 x 12 in.; pp. 930. $1.50.

FUEL ECONOMY IN THE OPERATION OF HAND-FIRED POWER PLANTS—Circular 7, Engineering Experiment Station, University of Illinois. Prepared Under the Direction of a Committee Consisting of A. C. Willard, Professor of Heating and Ventilation (Chairman), H. H. Stoek, Professor of Mining Engineering [and others]. Urbana, Ill.: University of Illinois. London: Chapman & Hall. Paper; 6 x 9 in.; pp. 94; illustrated. 20c.

GOVERNMENTAL WAR AGENCIES AFFECTING BUSINESS—Second Edition. New York: National Association of Manufacturers, 30 Church St. Paper; 6 x 9 in.; pp. 196.

Contains much useful condensed information regarding Federal legislation and agencies "which directly affect American business."

HANDBOOK OF MATHEMATICS FOR ENGINEERS—By Edward V. Huntington, Ph.D., Associate Professor of Mathematics, Harvard University. With Tables of Weights and Measures by Louis A. Fischer, B.S., Chief of Division of Weights and Measures, U. S. Bureau of Standards. Reprint of Sections 1 and 2 of L. S. Marks' "Mechanical Engineers' Handbook." New York: The McGraw-Hill Book Co. London: Hill Publishing Co. Flexible Leather; 5 x 7½ in.; pp. 191; illustrated. $1.50.

HELP WIN THE WAR BY PREVENTING UNNECESSARY SICKNESS: A Series of Important Wartime Messages to the People of Texas—Prepared by the Committee on Sanitation And Medicine of the Texas State Council of Defense; Charles Saville, Dallas, Secretary. Paper; 6 x 9 in.; pp. 31.

Reprints of weekly leaflets on health and sanitation issued weekly from November, 1917, to July, 1918. Typhoid, privies, swimming pools, hog raising for garbage disposal, and health protection of shipbuilders are among the subjects treated.

INSECTS AND DISEASE: A Statement of the More Important Facts, with Special Reference to Everyday Experience—By C.-E. A. Winslow and Frank E. Lutz. Guide Leaflet No. 48, American Museum of Natural History, New York City. Paper; 6 x 10 in.; pp. 73; illustrated.

Sufficiently popular to be understood by any intelligent person and yet thoroughly scientific, this is a remarkably compact, useful and entertaining review of disease-bearing insects and their control. Twoscore diseases, as many parasites and nearly as many carriers, are listed. Most attention is given to the fly as carrier of typhoid, the mosquito as the disseminator of malaria and yellow fever and the flea (together with the rat) as bearer of the bubonic plague.

INTERNATIONAL MINING LAW—By Theo. F. Van Wagenen, E. M., President and General Manager, The American Potash Co., Denver, Colo. New York: McGraw-Hill Book Co. Flexible cloth; 5 x 8 in.; pp. 342; $3.50.

Chiefly devoted to a review of mining law by countries of the world. A third of the volume treats the subject under such heads as "The Prospector," "Leasehold vs. Licensed Prospecting," etc. It is stated in the preface that practically all the basic material for the book was gathered to enable its author to pass judgment on the need for a revision of American Federal mining law. His conclusions on this subject are embraced in a chapter of five pages, entitled "Defects and Deficiencies of the American Law." The title seems to be a bad misfit. "Mining Laws of All Nations" would have been more correct.

MICHIGAN STATE BOARD OF HEALTH: Annual Report of the Secretary for the Fiscal Years ending June 30, 1916-June 30, 1917—Lansing, Mich.: State Board of Health. Cloth; 6 x 9 in.; pp. 237; illustrated.

MINISTER OF MINES: Annual Report, 1917; Being an Account of Mining Operations for Gold, Coal, Etc., in the Province of British Columbia. Victoria, B. C.: Minister of Mines' Office. Paper; 7 x 10 in.; pp. 457; illustrated.

MODERN MANAGEMENT APPLIED TO CONSTRUCTION—By Daniel J. Hauer, Construction Economist; Consulting Engineer. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 187; illustrated. $2.50

NEW JERSEY STATE DEPARTMENT OF HEALTH: Report for 1916-17. Trenton, N. J.: The Department. Cloth; 6 x 9 in.; pp. 373; illustrated.

Contains tabular information regarding New Jersey water-supply and water-treatment and sewage-treatment plants, besides vital statistics and many other data.

NEW YORK CONSERVATION COMMISSION: Annual Report, 1915—Albany, N. Y.: The Commission. Cloth; 6 x 9 in.; pp. 517: illustrated.

Among other matter this belated report contains results of water-storage and power studies and stream-gaging data.

OKLAHOMA SOCIETY OF ENGINEERS: Transactions, 1918. Oklahoma City, Okla.: H. V. Hinckley, Secretary. Paper; 6 x 9 in.; pp. 77; illustrated. $1.

PLATINUM AND ALLIED METALS IN 1917—By James M. Hill. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 21.

PORTS AND TERMINAL FACILITIES—By Roy S. MacElwee, Ph.D., Lecturer in Economics and Foreign Trade, Columbia University; Associate Member, Society of Terminal Engineers and American Association of Port Authorities. New York: McGraw-Hill Book Co. London: Hill Publishing Co. Cloth; 6 x 9 in.; pp. 315; illustrated with 117 line cuts and halftones. $3 net.

RESULTS OF MAGNETIC OBSERVATIONS MADE BY THE UNITED STATES COAST AND GEODETIC SURVEY IN 1917—By Daniel L. Hazard, Chief of the Division of Terrestrial Magnetism. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 64. 10c.

RESULTS OF OBSERVATIONS MADE AT THE UNITED STATES COAST AND GEODETIC SURVEY MAGNETIC OBSERVATORY NEAR HONOLULU, HAWAII, 1915-16—By Daniel L. Hazard, Chief of the Division of Terrestrial Magnetism. Washington, D. C.: Superintendent of Documents. Paper; 9 x 12 in.; pp. 101; illustrated. 30c.

RESULTS OF OBSERVATIONS MADE AT THE UNITED STATES COAST AND GEODETIC SURVEY MAGNETIC OBSERVATORY AT SITKA, ALASKA, 1915-16—By Daniel L. Hazard, Chief of the Division of Terrestrial Magnetism. Washington, D. C.: Superintendent of Documents. Paper; 9 x 12 in.; pp. 96; illustrated. 40c.

SUBMARINES: A List of References in the New York Public Library—Compiled by Mary Ethel Jameson, Science Division, with a Foreword by Simon Lake. The Library. Paper; 7 x 10 in.; pp. 83.

WATER COMMISSION OF THE TERRITORY OF HAWAII: Report to the Governor, January, 1918—Honolulu, T. H.: The Commission. Paper; 6 x 9 in.; pp. 53; folding map and diagrams.

Contains report and recommendations for legislation by A. E. Chandler, member California Water Commission, and considerable data on artesian wells in Hawaii.

WATER-SUPPLY COMMISSION OF PENNSYLVANIA: Report for 1916. Harrisburg, Penn.: The Commission. Cloth; 6 x 9 in.; pp. 203.

Chiefly hydrographic data. Some rainfall figures. Also text on navigation and other subjects.

WET LANDS OF SOUTHERN LOUISIANA AND THEIR DRAINAGE—By Charles W. Okey, Senior Drainage Engineer. Washington, D. C.: Superintendent of Documents. Paper; 6 x 9 in.; pp. 67; illustrated. 20c.

ZONING SCHEME FOR ST. LOUIS, MO.: Height, Area and Use Districts and Restrictions—Prepared by the City Plan Commission. [Harland Bartholomew, Chief Engineer.] Paper; 21 x 18 in.; 5 pp. text and diagrams, 11 maps. St. Louis, Mo.: Address the Commission. $2.11 postpaid.

Contains zoning ordinance which went into effect Aug. 15, 1918. The text is accompanied by numerous diagrams and by large colored sectional maps.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Philadelphia and New England in Water and Fuel Saving Campaigns

Sir—I have been much interested in the attitude of *Engineering News-Record* on the water meter situation in Chicago, as recorded July 18 and 25 and Aug. 1, pp. 111, 205, 241. Perhaps the situation in Philadelphia may be of value and prove an aid to the campaign in Chicago.

By an ordinance passed in December, 1916, all manufacturing establishments, business houses, hotels, saloons, and practically everything except residences, were placed arbitrarily on meters. By an ordinance passed last winter all connections made to the mains after May 31 of this year must be provided with a meter.

A committee has been appointed and is about to hold hearings to consider the question of universal metering for the city and to prepare an ordinance adopting such a policy and establishing a program for the introduction of the meters.

As far as I can learn, there is no opposition to this proposition and widespread sentiment in favor of it. The Real Estate Board of the city has come out in favor of it, provided only that one or two details, such as the collection of the water charge from the tenant instead of the owner, are adjusted.

Such a program, if adopted, would include some 300,000 residences not yet metered. I cannot forecast details but I think the fact that a committee has been appointed to consider the question, that no opposition has thus far developed, and that the principle has been indorsed by the Real Estate Board, which is the organization most vitally affected, is significant of the probable result.

You may likewise be interested in a proposed meeting of the New England Water Works Association to be held in Boston, Sept. 11 and 12, in lieu of the regular September convention. It is to be a business meeting, devoted principally to war-time problems, with the most emphasis laid on the fuel situation.

The association has had printed 10,000 posters, a copy of which I inclose. These are being sent to the various New England members, with the request that they be posted up in conspicuous places. It seems to me that advertising of this nature is rather an innovation with the New England Water-Works Association and perhaps is significant. The whole matter has been cordially indorsed by the Fuel Administrator of New England.

I have just received a communication from the Washington office of the Fuel Administration with suggestions that the matter might very well be more widespread among water-works organizations.

Philadelphia is putting up several hundreds of these posters, modified to meet local conditions. Perhaps Chicago could use them as an aid in the meter campaign.

Approved by U. S. Fuel Administration for New England

You Can Have
More Coal for Your Cellar,
Water Consumers

Stop	**Look**	**Listen**
All Waste	**at Fixtures**	**for Leaks**

Hoover says Save Meat, Sugar and Wheat

We Say

Save water also

Because

Saving Water Means Saving Coal.

In the Pumping Stations
150,000 Tons of Coal a Year
in New England
Will Be Saved if Waste of Water
Is Stopped.

Remember the Zero Weather of Last Winter and Stop Waste Now.

NEW ENGLAND WATER-WORKS ASSOCIATION

It is the thought of the New England Water-Works Association that this is a year when excursions, entertainment, etc., should be omitted and the convention be made a business session only. Naturally, Boston is the logical place to hold such a meeting.

C. E. DAVIS,
Chief, Bureau of Water.

Philadelphia, Penn.

Committee on Development, American Society of Civil Engineers

Sir—It was a stimulating pleasure to me to read the preamble and resolutions adopted by the board of direction of the American Society of Civil Engineers, June 18. I believe these resolutions must meet with the unanimous and hearty indorsement of all members.

It is generally conceded that the American Society of Civil Engineers has been conservative; sometimes too conservative. This is a virtue rather than a fault. A tendency toward ultra-conservatism was the fault to be feared. The society has always stood for standards. Its work has been a dominant influence both for American engineers and for the American public.

Times are now wonderfully changing, just as was the case a century ago in the flux of the French revolution. It is only natural, therefore, that we should suddenly feel an impelling need for "a broad survey of the functions and purposes of the American Society of Civil Engineers." Indeed, I think development and readjustment are to be demanded, not only in other na-

tional engineering societies, but in every human organization dealing with the problems of society. "Surveys" will surely be made in the learned professions, in business, in government and in the great questions confronting capital and labor.

The conservative American Society of Civil Engineers has become a pioneer grasping leadership in a great social movement.

Who would have predicted ten years ago that in 1918 there would be 22 local associations of members of the American Society of Civil Engineers? Even before the great world war brought its tremendous influences engineers were feeling the need for correlation and combination. Our national societies must be knit more closely together. Happily this is being accomplished now with rapid strides through the medium of an Engineering Council.

The applications of applied science are complex and manifold. We will always have many societies representing specialties. Such societies must be recognized; but in dealing with the public, with government problems, with war work, all engineers must coöperate, for no one man or no one society of engineers can be a specialist in everything. Great gain will come to the engineering profession and still more gain to the public when engineers of every branch act more in unison.

This is to be accomplished by coöperation of the great national societies. To the public the engineering profession must present one solid front.

We may confidently expect that the committee on development of the American Society of Civil Engineers will not only revise the constitution of that society but will do a pioneer's share toward framing "the purposes, field of work, scope of activity and usefulness, organization and methods of work" of the great engineering profession as a whole.

Berkeley, Calif. C. DERLETH, JR.,
Dean, College of Civil Engineering,
University of California.

[In connection with this, this journal calls attention to the letter in the *Journal* of the American Society of Mechanical Engineers for August, by Louis C. Marburg of Philadelphia, in which he suggests the appointment of a similar committee by that society, and urges joint activity by national societies when general and identical aims are to be achieved.—Editor.]

Co-operation in Industrial Research

Sir—In your issue of June 20, p. 1161, there is a timely editorial entitled "Concentrate Engineering Talent and Experimental Facilities on the War." Doubtless it is the desire of all American engineers to do just that, including the engineers employed by the Government in military service, and otherwise those employed by manufacturing concerns and those in a consulting capacity.

The difficulties of concentrating facilities are largely due to the fact that the man who wants information or assistance does not know just where to go to get it. At the meeting of the American Society for Testing Materials in June, during the topical discussion on coöperation in industrial research, it seemed worth while to say a word on one phase of this situation, wherein the writer's observations led him to believe that engineers in the producing class are not afforded an opportunity to be of the greatest possible assistance to engineers in the Government service.

In the development of the military program especially, there are many research problems which must be worked out in the laboratories of the various and numerous Governmental departments and bureaus. These problems cannot always be placed in the hands of investigators who are thoroughly familiar with the materials to be dealt with, and they will, therefore, turn to the producers of materials for information and for samples. Often, in asking for this information, the Government representatives do not give the manufacturer much indication of the purpose for which the material is to be used. Circular letters are frequently sent out asking for samples, prices, quantities available, etc., and it is frequently impossible for the manufacturers to answer such letters intelligently without knowledge of the technical purpose and relative urgency of the proposition.

The writer urges that better facilities be afforded producers to give full service in such matters, and suggests that wherever circumstances permit the responsible technical heads of well-recognized producing organizations be approached in person by well-accredited representatives of Government departments, so that a mutual feeling of assurance may be had regarding the confidential character of the information exchanged.

S. R. CHURCH,
New York City. The Barrett Company.

Owners Backward in Matter of Contract Practice

Sir—I have read with much interest the article in your issue of July 18 by your managing editor, Henry D. Hammond, under the caption, "New Contract System which Stimulates Efficiency Gaining Favor."

The system which he recommends is an important move in the right direction, and is the only method that can produce proper results. In my practice I have advocated this very system for a number of years, but have found it very difficult to convince clients that this was the best method for them to pursue, as in most cases they favored the straight out competitive system, for the reason that it gave them an opportunity to take advantage of any attractive low bids they might receive, notwithstanding the fact that they are advised that the work cannot be performed properly for the lowest figure.

It is difficult to convince them why they should not take advantage of this low figure. If they can obtain from the contractor a bond for the faithful performance of his contract, they feel assured that this will protect them against any delinquency of the contractor, and that by virtue of this bond they will secure the same efficiency and standard of work that would be obtained had a fair value been paid for the work. This they consider good business, believing that they are receiving something for nothing, or at least getting work below cost.

It is needless to remark, however, that is just where they are being deceived. They are not making the saving that they think they are, but merely putting a premium on inferior work and stimulating the efforts of the contractor in that way to even up his losses, and also in many cases inviting legal complications. But

the temptation is so great to take this advantage that it is difficult in many cases to overcome it by argument.

The unfavorable conditions, friction and legal complications surrounding the competitive contract methods, in many cases, demonstrate the fact that the principle underlying this method is wrong. A system that creates antagonism between contractor and owner, permitting unfair advantage to be taken by either party, thereby producing possible failure for the contractor and endless trouble and litigation for the owner, certainly proves that it lacks in some essential point.

The method advanced by Mr. Hammond, and which I have advocated for so many years, eliminates all of these objectionable features, is equitable, and places all concerned—owner, engineer and contractor—in harmony, thereby producing the best results.

A system or method employed in carrying out the work of any contract that makes the interests of the owner and contractor identical, and whereby the owner and contractor work together as a unit for one common end, devoid of all friction and suspicion, is the only method that can succeed, bring the best results and complete the work with entire satisfaction.

A responsible contracting engineer with experience knows what work will cost when letting contracts, and if the work is being carried out under this system is able to effect savings, from time to time, which will accrue to the benefit of the owner. The owner is at all times kept informed as to the status of the work; knows that he is buying right; has the knowledge that the materials and labor are being paid for, and is free of all legal entanglements, for the reason that under this method he receives clear records of all transactions; and the contractor, being relieved of the financing, is free to give his full energy and best efforts to the prosecution of his work. There is consequently the greatest freedom from friction and worry, and the greatest pleasure in the gratifying results achieved by this coöperation.

It is hard to believe, and I regret to say it, but there are some business men who by using the usual competitive method take advantage of the contractor who has omitted something from his estimate, or who has not had enough experience to know what the work he is bidding on will cost. Such men will receive the lowest bidder with open arms, and, regardless of his ability to do good work or of any consideration of its real value as it should be performed, will expect to obtain first-class and efficient work. Such procedure mostly carries its own penalty.

The method advocated in Mr. Hammond's article avoids these entanglements—you get what you pay for and pay for what you get, making a square deal for all concerned. This system adopted, but with a positive, agreed sum for services, is preferable and an improvement over the percentage system, for the reason that it eliminates from the mind of the owner the suspicion of an incentive on the part of the contractor to increase the cost so as to increase his profit. This is one serious objection the owners make in adopting the percentage system. But where the owner and contractor agree on a fixed sum at the outset, this objection is overcome. I am aware that there are legal difficulties in the way of using this system for public work, owing to the laws prescribing competitive bidding and the straight form contract with the acceptance of the bid of the lowest bidder, if he is able to qualify.

The Government, however, is now letting contracts for war emergency work on a percentage basis, which is a move in the right direction, but has not as yet reached the point where the temptation is eliminated for unscrupulous contractors to increase the cost so as to increase their profits.

COL. F. J. AMWEG.

San Francisco.

Record for Continuous Pile Driving

Sir—I note in the press of recent date claims of record for driving piles by the Raymond Concrete Pile Co. based on a one-day performance at Hog Island of 165 piles, another claim by Siems, Helmers & Schaffner of St. Paul for the same honor, one of this firm's crews having driven 168 piles in nine hours, and a further one-day record at Hog Island of 220 piles.

I do not like to see a record claimed by others when I believe the real record, at least for sustained performances, was made several years ago by A. F. Chapman & Co. of Buffalo on work for the Buffalo & Susquehanna Iron Co., under the supervision of the writer, when 1200 piles 35 ft. long were driven every week for 5 weeks with one machine using a No. 1 Vulcan hammer, working 9½ hours per day and half a day Saturday. These piles were driven 3 ft. below ground, necessitating the use of a set on each pile. This means one pile driven in less than three minutes from Monday morning until Saturday noon.

CHESLEY, EARL & HEIMBACH, INC.,

Buffalo, N. Y. J. B. CHESLEY, President.

Survey Desert Highway Route at Night

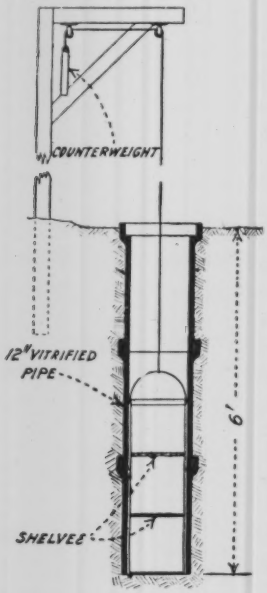
So great are the difficulties encountered in locating the 17-mile tangent of the Lincoln Highway crossing of the Utah desert in the daytime that the work has been carried on at night. The sunlight, reflected from the fields of glistening salt and alkali, is so dazzling that it blinds the eyes, unless they are protected by dark-colored glasses, and the rising heat waves distort the shapes of objects sighted and produce fantastic effects. These factors and the familiar mirage would result in inaccuracy and confusion unless proper methods were employed for establishing the lines. Under George F. McGonigale, state engineer and a member of the State Road Commission, this tangent was established by signal fires at night. The connecting levels and transit lines have been run during the twilight hours. Construction of the new direct route, which will eliminate 50 miles of extra travel around the south point of the salt marsh, is under way. A force of convicts is also improving the Fisher Pass section. C. V. Gardner, field engineer, is installing 6000 ft. of pipe from Cold Springs to the route. Ira R. Browning, state road engineer, writes that the final location of the Utah desert section is nearly completed. Trucks and caterpillar graders have been furnished to R. E. Dillree, construction superintendent, for the grading and gravel surfacing of this section. Shortage of labor is the greatest handicap, but this is made up for as far as possible by the use of machinery.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Drain Pipe and Tin Bucket Provide Iceless Refrigerator

CONSTRUCTION camp refrigerators consisting of three lengths of vitrified pipe set vertically in the ground and forming a well into which a food container is lowered by rope and pulley are designed to help solve the problem of the iceman on the Dayton flood prevention work. Three lengths of drain pipe make a well 6 ft. deep as shown by the drawing. At this depth the ground is as cool as the inside of the ordinary refrigerator. To contain the food, a tin bucket 11 in. in diameter and 3 ft. high is fitted with shelves and a full-length hinged door, and provided with a bail for handling. Two pulleys, a length of rope and a counterweight complete the outfit. Ordinarily, the pulleys are fastened to the kitchen shed roof, but a post and bracket like those illustrated may be employed. Any tinsmith can make the bucket, using inch boards for the shelves. This iceless refrigerator was devised by H. H. Rupe, superintendent of carpenters at the Englewood reservoir.



TILE LINED COOLING WELL

Sewer Invert Forms Hung from Tunnel Sets by T-Square Rig

BY R. W. STEWART

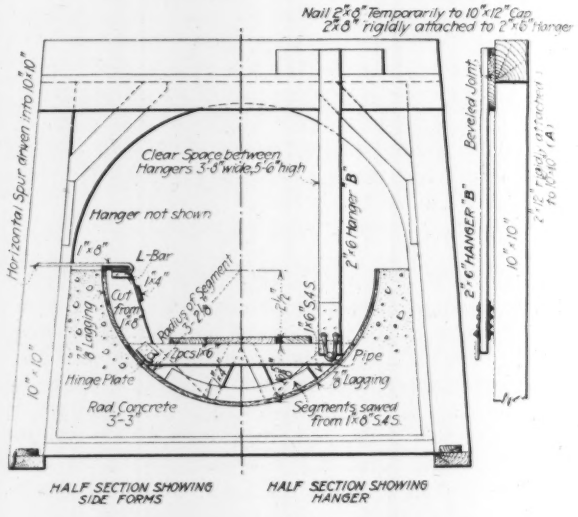
Engineer of Bridges and Structures, City of Los Angeles, Cal.

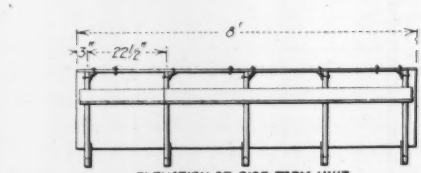
FORMS for the concrete invert of a new 4000-ft. sewer tunnel at Los Angeles were of standard wood sections carried on a specially designed rig which was suspended from the cross-frames of the tunnel sets. The forms were used over and over, and were readily moved along the line of the tunnel.

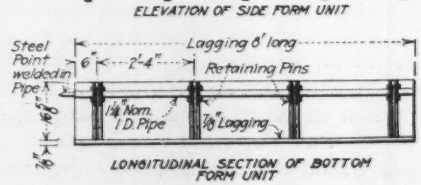
As shown in the drawing, at A, 2 x 12-in. strips with one beveled edge were nailed across the timber sets. These were set by a level party on a grade exactly parallel to and a constant distance above the grade of the sewer. Hangers B in the illustration), shaped like T-squares, with 2 x 8-in. crossheads beveled on the lower edge to fit the bevel on the strips A, were then suspended, one on each side of the center line, the crossheads being also nailed lightly to the caps of the tunnel sets in such a manner that the nails could readily be withdrawn to move the hangers ahead. The bottom of each hanger was reinforced by a 6 x ¼ x 11-in. steel plate in order to make a suitable tension joint for bolting on the U-hanger (or clevis) as shown. The nuts for the clevis bolts were "box rod handle nuts" which could be quickly applied or removed without a wrench.

From this hanger were suspended the invert forms. They were built of wood in 8-ft. sections, a complete assembly consisting of one bottom form unit and two side form units. These units were light enough to be readily carried along the work. The 1¼-in. pipes which pass through the crossframes of the bottom form units were each equipped with an iron point welded in one end. By inserting the projecting points of the pipes at one end of a form unit into the open ends of the pipes of the next form ahead a rigid coupling was immediately established between adjoining forms which prevented their lateral or vertical displacement with reference to each other at abutting joints.

Passing the clevises under the pipes and bolting them to the bottom of the hangers suspended the bottom form units at the correct grade. The 2 x 6-in. stem of each







INVERT FORMS ARE HUNG FROM TUNNEL SETS

hanger was cut to a contact fit with the pipe so that the form could not rise from the upward pressure of concrete underneath.

When the concrete was poured to the level of the tops of the bottom form units, the side form units, the construction of which is readily understood from the drawing, were set upon the pipe. The ribs of the side form units are staggered with reference to the crossframes of the bottom form units. The tops of the side forms were quickly and easily aligned by means of steel rods each having one end bent down into a hook which was passed around the edge of the 1 x 8-in. wale at the top of the side forms and the other end bent out horizontally into a spur which was driven into the side of the tunnel post or to projecting pieces. Two hundred linear feet of forms were built. The nominal progress made in laying concrete was 35 ft. per day. While concrete was being poured at the front, forms were being detached at the rear. A night shift carried the loose forms from the rear and erected them in front for the next day's pouring. The original forms lasted until the work was complete, and the metal fixtures are now in storage. Since the design of all of the metal parts is independent of the diameter of the sewer they are well adapted to repeated use.

Other Articles In This Issue of Interest to Contractors

Coördination Saves Six Weeks' Construction Time on Big Building Page 300
Derrick Car Places Deck Slabs of Concrete Bridges Page 307
Temporary Timber Bents Rapidly Repair Destroyed Flume Page 316
Owners Backward in Matters of Contract Practice (Letter) Page 330
Record for Continuous Pile Driving (Letter) Page 331

Reline and Waterproof Mine Shaft With Cement Gun

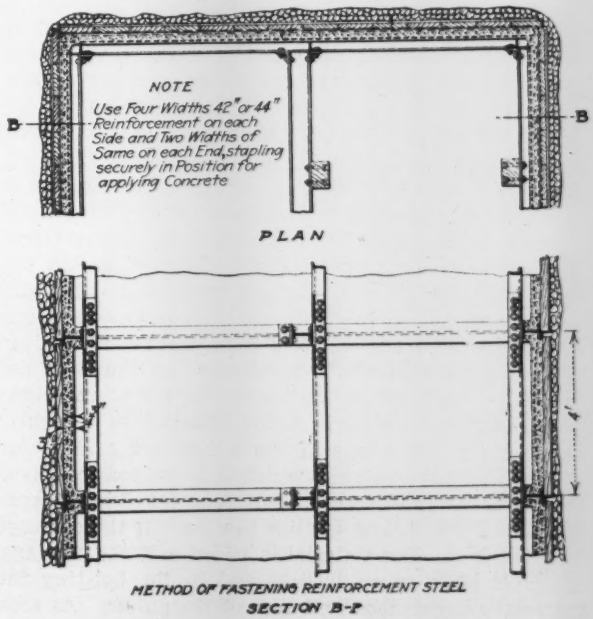
TEN mine shafts on the iron range in Minnesota have been relined with precast concrete lumber in the past four years, and in many others monolithic concrete has been placed. Recently the cement gun has been employed to reline the Penobscot pump shaft of the Oliver Iron Mining Co., at Hibbing. This shaft, built up of steel sets and 2-in. wood lath, was put down in 1911. It was finished in 1912 to a depth of 231 ft. All of the water from the Hull-Rust pit, one of the largest open-pit mines in the world, is pumped out through this shaft. Originally the pumps handled 1000 gal. per minute, but now the total is only 400 gal. per minute.

The shaft is about 11½ x 6 ft., with two compartments 5½ x 6 ft. Steel sets are made up of 6-in. H-beams while dividers are 6-in. I-beams. Sets are spaced on 4-ft. centers.

Work was started at the top and proceeded at the rate of two sets per day, making a total of 8 ft. Concrete was placed in two layers, each 2 in. thick. Sollars or temporary platforms were put in every 15 to 20 ft. in order to catch the rebound which dropped into the shaft, and to prevent accidents from falling materials. Permanent ladders were removed as the work proceeded, in order to give the men space in which to work. Sets were concreted in order, except those in which the sollars were placed. After the concrete had hardened in the sets around the sollar sets, the sollar was dropped and the set concreted.

Reinforcing was put all the way down the shaft, as the first step. This was wire mesh, cut into lengths of 4 ft. so that when placed between the sets it would curve out, forming tension reinforcement near the interior face. To hold the reinforcement in place hook spikes made from ½-in. rods were driven into the timbers, close to the sets. As the sand and cement mixture left the cement gun, it dropped down into the shaft through a 1½-in. hose. Wear on the rubber connections from the gun to the delivery hose necessitated its replacement several times. Otherwise no repairs were needed. Six men were employed besides the foreman, who gave only a part of his time to this job. Three men measured the sand and cement, mixed the materials and carried the mixture to the cement gun. One man attended to the gun and two men were down in the shaft handling the nozzle. While one was busy with the nozzle the other would be trimming. Sand was obtained from a bed in an open-pit mine, brought to the job in 7-yd. wooden dump cars, screened through ½-in. mesh and dried with steam coils.

Though the workmen had no experience to begin with, they were of an intelligent laboring class and were able to do the work satisfactorily after a little training. For a 10-hour day the ordinary work of six men was three sets or 12 ft., applying a layer of one coat 2 in. thick. The best results were obtained when the sand was thoroughly dried and mixed with the cement before being placed in the cement gun, and batches of 1 to 1½ cu.ft. were handled by the gun much more satisfactorily than larger batches. With these precautions the flow to the hose could easily be regulated,


NOTE
Use Four Widths 42" or 44" Reinforcement on each Side and Two Widths of Same on each End, stapling securely in Position for applying Concrete
B
B
PLAN
METHOD OF FASTENING REINFORCEMENT STEEL
SECTION B-B

CEMENT GUN MORTAR LINES MINE SHAFT

making it possible to place the concrete smoothly on the walls of the shaft.

Sand was heated in a specially built drier seven coils wide and seven coils high and 12 ft. long, made of 1½-in. pipe. It would sift down through these coils and be perfectly dry when it reached the bottom. A double ¼-in. mesh screen, placed on a slant, was used directly above the coils. Experience with this improvised drier showed that it would have been more efficient if the pipes had been shorter. Steam was obtained from the stationary plant at Penobscot mine, while the air used in operating the gun was furnished by a Westinghouse air pump, furnishing about 220 cu.ft. a minute, carrying 70 lb. pressure. At the nozzle the air pressure was from 20 to 22 lb., and water pressure 100 pounds.

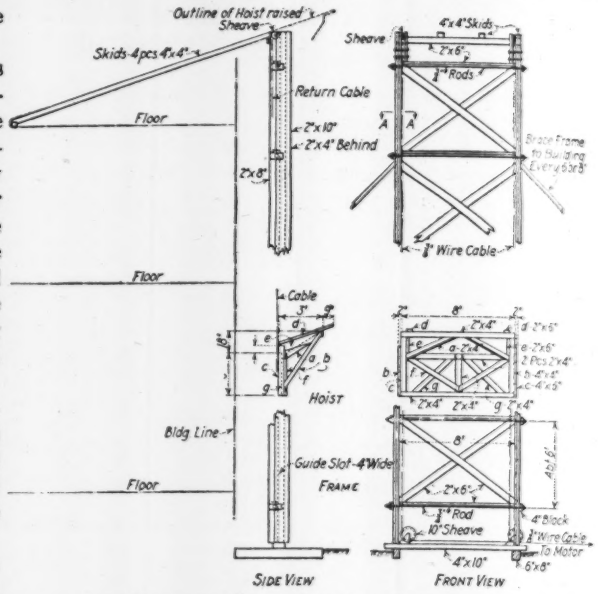
In experimenting it was found that if the sand and cement were placed in the gun separately and then mixed there was considerable waste material from the rebound when the concrete was shot on the wall. After the dried sand and cement were mixed before being put into the gun, this waste material decreased decidedly.

Sollars which were put in every three or four sets were cleaned up every day. They were made of 2-in. plank extending 4 in. on either side of the compartment so as not to slide out. At the end of each day's work the hoses, nozzles and gun were completely cleaned out. Every effort was made to protect the men from injury.

After the shaft was lined no trouble was encountered from water, and the mine officials were so pleased that they decided to use the cement gun in pointing up joints in the Philbin shaft where precast lumber has been used for the lining. Below the 75-ft. level water was entering, but was stopped by a single coat of cement-gun concrete which prevented any further infiltration.

"Long-Stuff" Elevators Handle Reinforcing and Forms

ELEVATORS built specially for hoisting "long stuff" in a vertical position helped materially in building the new quartermaster's depot at Chicago, described on page 300. The drawings show this elevator, which can be readily rigged up with the means at hand on any fair-sized job. The guides are made by bolting or nailing a 2 x 4- and a 2 x 8-in. timber to a 2 x 10-in. plank, leaving a groove 4 in. wide and 2 in. deep, which receives the hoist. The hoist or carriage is built of 2 x 4-in. material and is 8 ft. wide. For reinforcing material a cradle long enough to accommodate the longest iron is attached to the short carriage. In erecting the elevator, the guide pieces are set out from the building at a distance of 2 ft. 8 in. Two cables, one on either end of the carriage, are led over 6-in. sheaves at the top of the frame, through 10-in. sheaves on the base and thence to the drum of the hoist. In the present case the hoist was an electric motor attached to a regular hoisting rig. The tops of the guides are carried far enough above the point at which it is desired to deliver the materials to place a skid of four 4 x 4-in. timbers at an incline sufficient to slide the load off the carriage onto the floor. The material is loaded onto the carriage, which is built on an incline, and in the hoisting the material rides on the front edge of the guides. As soon as the carriage has reached the top the load clears the



ELEVATOR TRAVELS ALONGSIDE OF BUILDING

top of the guides and slides down over the skids onto the floor. All that is necessary to make the operation of this elevator a success is to keep the grooves in the guides and the skid thoroughly greased.

How to Make Patches on Concrete Surfaces

BY RUDOLPH N. MAXWELL
Cincinnati, Ohio

PATCHES can be applied to new concrete surfaces with great success by a method the writer has been using for some years. Start the patching as soon as possible after removing the forms, but do not remove the forms so early as to damage the sharp angles or as to leave unsightly places due to the concrete sticking to the forms while green. After cleaning from the concrete to be patched all loose material, by means of a wire broom or other device, wet the surface thoroughly with water. While the surface is still wet take the mortar, usually composed of a 1:2 mixture of cement and finely screened sand in a slushy state, and throw or press it into the opening with as much force as possible, building up a little at a time if the hole is a large one.

Then take a small block of wood, with sharp edges, about 1 in. thick and 2½ to 3 in. square and rub flatwise in a circle, scraping off all excess material until the general surface of the old work shows and until no more mortar remains than is absolutely necessary to fill the open spaces. Just before completing this operation, rub the block of wood in the direction of the board marks, as a painter does with the last strokes of the brush. If the board marks of the original work are to show, take a sharp instrument and connect up the board lines on the surface of the patch, making it like the other work.

A little practice with the small block of wood will result in superior work, much better than if the mortar is finished with a trowel or if done with a large block of wood or float, which is entirely too big for the best results.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

War Department Establishes Materials Section

Will Redistribute Equipment and Material for Which Original Use Does Not Exist

(Washington Correspondence)

Hundreds of millions of dollars will be saved to the Government and taxpayers of the United States by a new bureau which has been established in the purchase and supply branch of the General Staff, under Gen. Hugh S. Johnson, director of purchases and supplies. The new bureau will have charge of what is to be known as the Surplus Inactive Supply Service, and by direction of the Secretary of War its work will be carried on, through General Johnson, as a branch of the office of Maj. Gen. George W. Goethals, assistant chief of staff and director of purchases, storage and traffic.

The work of the new bureau, as indicated by its name, is made possible by the fact that much War Department material and equipment becomes available or has become available, owing to changing conditions at the front in France and upon other fronts, for needs other than those originally intended to be filled. For instance, some time ago 36 wagons to be used in construction work were ordered for General Pershing, but the troops in charge of that particular piece of construction managed to finish what they were doing by ingenuity, using other equipment right at hand, and General Pershing cabled that it would not be necessary to ship the wagons. Now, through the work of the new Surplus Inactive Supply Service, these wagons will be used in construction work in this country.

Again, it has been found that there are about 2000 tons of special steel on hand, which were ordered for a particular branch of the War Department. It was ascertained in this, as in other cases, that the war has advanced more quickly than production, and this particular steel was not needed for the purpose originally intended, as other material was gotten out which could be put into production more quickly. The result is that under the work of the new bureau this steel will be turned back into other Government industry, where it will do the most good quickly toward winning the war.

Aid to Contractors on War Work

The new bureau will have before it all the time a current list of all this War Department surplus material and supplies, which might be regarded as inactive. A copy of this list or bulletin will be kept in the current desk files of all the purchasing divisions of the War Department, and the new bureau will have representatives in each division. Reference will be made to these lists, to see what the War Department has on hand, before purchases are made or new contracts are let. If a contractor turning out Government work is running short of certain material needed, he will be able to get in touch with the new bureau through the division of the War Department which made the contract with him, and it will be ascertained whether what the contractor needs is on the list of so-called inactive supplies, or it will be ascertained whether the new bureau has knowledge of the likelihood of material needed becoming available soon. The desire is to fill up shortage in industry and in the different purchasing divisions of the War Department. A few tons of steel, some brass or copper rods of a certain character or size, might hold up a great program, or delay General Pershing's supplies for the troops at the front.

To Co-operate with Industries Board

When material or equipment is found which is not wanted by any branch of the War Department, the case is taken up with the War Industries Board, and advice is sought as to where the material and equipment can be used to the best advantage in some war or other essential industry. Then, steps are to be taken so that the particular branch of industry most affected may have the opportunity of purchasing under the system of competitive bids.

Questionnaires for the purpose of taking a census are being sent out. Aside from the saving of hundreds of millions of dollars to the taxpayers and the Government, it is expected that the work of the new bureau will save a tremendous amount of time, labor and material, more essential in the winning of the war than the mere money involved.

War Department To Share Cost of Building Road

The expenditure of $95,000, as the War Department's share in the cost of building a road from Camp Gordon, Georgia, to the Norcross Rifle Range, has been authorized by the department. The total cost of the road is estimated at $190,000.

The present road between the two points runs through clay and it is frequently impossible to reach the range with heavy trucks. As this road will be used chiefly by the military authorities, the latter will bear the greatest part of the expense. The State of Georgia will give $65,000, while DeKalb and Gwinnett counties, through which the road runs, will each contribute $15,000.

No Engineer Commissions Until Draft Law Passes

Baker Order Suspending Civilian Entrance to Officers' Camps Applies to Drive for Engineers

Engineering News-Record is informed by Chief of Engineers Black that the recent order of Secretary Baker suspending all volunteering and the entrance of civilians in the officers' training camp applies also to the current drive to obtain first lieutenants and captains of engineers. The suspension lasts only until the new draft law is enacted, at which time conditions for entrance to camps will be announced.

The order is expected to be only temporary in so far as it affects the engineer officers' camp. All accepted candidates examined up to and including Aug. 13 will be commissioned without undue delay. Candidates examined after that date must await further developments. The Office of the Chief of Engineers will continue to receive applications and the examining board will continue its itinerary and examination of all candidates.

The board has already visited New York, Boston and Chicago and intermediate points. Its itinerary up to Sept. 16, when it returns to Washington, is as follows:

St. Louis, Aug. 15; Kansas City, Aug. 16-17; St. Paul, Aug. 19-20; Denver, Aug. 22; Salt Lake City, Aug. 24; Butte, Mont., Aug. 27; Seattle, Wash., Aug. 29-30; Portland, Ore., Aug. 31; San Francisco, Sept. 2-4; Los Angeles, Sept. 5-7; Deming, N. M., Sept. 10, and Dallas, Tex., Sept. 13.

Adjust River and Harbor Contracts To Increased Cost

The recent rivers and harbors act provides that the additional unexpected cost of labor and materials for certain work undertaken by the War Department shall not fall on the contractors who could not foresee such increases when they bid on the work. The plan reads as follows:

"That if the Secretary of War shall determine that any of the contracts for work of river and harbor improvements entered into but not completed prior to April 6, 1917, the date of the entrance of the United States into the war with Germany, have become inequitable and unjust on account of increased costs of materials and labor and other unforeseen conditions arising out of the war, he is hereby authorized, in his discretion and with the consent of the contractors, to modify and readjust the terms of said contracts in such manner as he may deem equitable and just: Provided, That such modifications and

readjustments shall apply only to work under said contracts remaining to be done hereafter and shall not include any relief for work performed heretofore under said contracts, and any such sum as may be necessary to provide for the increased cost of the contracts due to said modifications and readjustments, not exceeding the sum of $2,000,000, is hereby appropriated out of any money in the treasury not otherwise appropriated; Provided further, That as a condition of any such contract being so modified, the Secretary of War shall have the right, at the end of any fiscal year, until the contract is completed, to make such further modifications as in his judgment shall be advantageous to the United States and just to the contractor."

Camp Sewage Disposal Works Will Be Enlarged

Enlargement of sewage disposal plants at army camps and cantonments will be undertaken immediately by the Construction Division of the Army, according to a statement authorized by the War Department. The average cost of the work at each camp will be about $40,000. The enlargement has been made necessary by the increased number of troops. The decision announced followed a visit to the plants by a committee of sanitary engineers from the Construction Division and the Sanitary Engineering Section of the Surgeon-General's office. The committee reported that enlargements and alterations of the various plants must be made to safeguard properly the health of the troops and of the civilian population.

Men Wanted at Once by the Division of Engineering

One production and efficiency man, an expert bridge designer and four engineers of tests are included in the list of men wanted at once by the division of engineering, United States Employment Service. The division of engineering will not consider applicants who are already engaged in essential industries, as it is concerned only in filling war needs and not in creating them. All men wishing to enter the service of the division of engineering should write at once for application, addressing A. H. Krom, Director of Engineering, 29 S. LaSalle St., Chicago, Ill.

Board for Denver Water-Works Under City Ownership

Besides voting 6248 to 1800 to buy out the Denver Union Water Co., on Aug 7 the electors also indorsed by a large majority the board of five citizens selected by the city government to manage the works. These men are: John C. Skinner, Frank L. Woodward, Benjamin A. Sweet, Charles H. Reynolds and Finlay F. MacFarland. The plant will be taken over as soon as feasible. A general director or manager will be appointed.

Probably No Local Sections of National Societies

New Engineers' Club at Duluth Admits Members of Six National Societies Without Formalities

(Editorial Correspondence)

The Duluth Engineers' Club was organized Aug. 5 at a meeting at which Alfred D. Flinn, secretary of the Engineering Council, was the principal speaker. The purposes and aims of this new organization may best be told by the following paragraph taken from the articles of incorporation:

"Its general purpose is to create an instrument by which united action can be obtained by the members of the engineering profession in Duluth and vicinity; to serve the community, state and nation better than in the past; to raise the standards of the profession and the ideals of the individual; to make the profession more worthy of consideration by the community; to awaken among engineers an interest in all civic matters in general, and particularly in regard to matters for which the engineer, because of his training, should feel a peculiar civic responsibility; to make the community aware of the service the engineering profession is prepared to render; to add to the scientific knowledge relating to engineering; to increase social intercourse between members of the profession; and in general for uplift of the community, the profession and the individual."

At the time of organization and for a period of 90 days thereafter any member of the six national engineering societies (including the Chemical Engineers and Society for Testing of Materials) is eligible to membership without any formality upon the payment of annual dues. Qualifications for the two classes of membership are: Members, 10 years in active practice and three years in responsible charge; or a technical graduate with three years' actual practice and one year responsible charge; juniors must be actively engaged in engineering work or pursuing a course of study in engineering and at the age of 32 they must apply for advancement to member. The club starts with a membership of 87.

The officers selected, all of whom are members of some one of the national engineering societies, are: President, W. C. Swart, M. Inst. Min. E.; first vice president, E. R. Lewis, M. Am. Soc. C. E., chief engineer and assistant general manager of the Duluth, South Shore and Atlantic Ry.; second vice president, W. N. Ryerson, F. Am. Inst. E. E., general manager of the Great Northern Power Co.; secretary, W. H. Woodbury, M. Am. Soc. C. E., valuation engineer, Duluth & Iron Range Ry.; treasurer, W. H. Gallagher, M. Am. Soc. M. E., chief engineer for Peckans, Mather & Co.; board of directors, F. E. House, M. Am. Soc. C. E., Federal general manager of the Duluth, Missabe & Northern Ry. and Duluth & Iron Range R.R.; T. W. Hugo, M. Am. Soc. M. E., consulting mechanical engineer; W. F. Schwedes, Assoc. Am. Inst. E. E., electrical engineer for the Oliver Iron Mining Co.; W. J. Downing, M. Am. Inst. Min. E., chief engineer for the Shenango Furnace Company.

After two years of study of methods of organization it has practically been agreed that there should be no local chapters of the national societies in Duluth, and all society activities shall be carried on through the newly organized Duluth Engineers' Club.

Postpone Construction of Milwaukee Sewage-Works

Construction of the Milwaukee sewage treatment works has been postponed for the duration of the war. The intention had been to start building this year. Work on the intercepting system will be continued. This will divert sewage from the various river and lake outlets and concentrate it at Jones Island, where it is the intention to treat it temporarily with chlorine after passage through grit chambers.

Seattle May Sell $5,500,000 Bonds for Hydro-Electric Plant

Seattle has been authorized by the Capital Issues Committee to sell $5,500,000 of bonds for a 35,000-kw. unit of its Skagit River hydro-electric project, already authorized by popular vote. Only $1,500,000 of the bonds may be sold in 1918, and $1,000,000 every six months thereafter. Capital charges on the bonds must be met from the earnings of the municipal lighting department, of which J. D. Ross is superintendent. The bond issue authorized is designed to cover what will be known as the Gorge Creek unit. The city has water priority rights on two other sites. It is estimated that 200,000 to 250,000 kw. could be developed at the three sites. It is reported that the Capital Issues Committee advises connecting the light and power systems of the city and the Puget Sound Traction, Light & Power Co., so any surplus power of either may be used in the other and duplication of service during the war be obviated.

An outline of the application of the city of Seattle to the Capital Issues Committee was presented in *Engineering News-Record* of Aug. 1, p. 248.

Permanent Highway Transport Committee for New York

A permanent organization of the Highways Transport Committee of the State of New York was formed July 7 at Albany at a meeting attended by David C. Fenner, of the New York City Merchants' Association; George H. Pride, of the Heavy Haulage Co., of New York; George C. Diehl, county engineer of Erie County; Edwin A. Duffey, state highway commissioner, and others. The Hon. Peter Ten Eyck, of Albany, was chosen as state chairman. It is the purpose of the new organization to promote return loads bureaus and motor express routes throughout the state. The New York Merchants' Association has already established a successful bureau of this kind.

Directors of Students' Army Training Corps Named

Well Known Educators Appointed To Be Divisional Heads of College Military Instruction

Divisional directors have been appointed to coöperate in the formation and educational supervision of the Students' Army Training Corps, which, as announced in these pages some weeks ago, provides for the enlistment of men below the present draft age, in a special branch of the army and grants permission to them to attend, on furlough, technical schools for instruction. Units of the corps will be established at virtually all colleges having a minimum enrollment of 100 able-bodied male students.

President McLaurin of the Massachusetts Institute of Technology has already reported in Washington as the educational director of the corps. The divisional directors are as follows: New England States, Charles H. Haskins, dean of the Graduate School of Arts and Sciences, Harvard University; New York and New Jersey, Charles A. Richmond, chancellor of Union University; Pennsylvania, Maryland and Delaware, John Henry MacCracken, president of Lafayette College; Virginia, North Carolina, South Carolina, Georgia and Florida, Edward K. Graham, president of the University of North Carolina; Kentucky, Tennessee, Alabama, Mississippi, Louisiana and Arkansas, Bruce R. Payne, president of George Peabody College; Ohio and West Virginia, Raymond M. Hughes, president of Miami University; Michigan, Wisconsin and Indiana, Mortimer E. Cooley, dean of the College of Engineering and Architecture, University of Michigan; Illinois, Missouri, Kansas and Colorado, A. Ross Hill, president of the University of Missouri; Texas, Oklahoma, New Mexico and Arizona, Robert E. Vinson, president of the University of Texas; California, Nevada and Utah, Ray L. Wilbur, president of Stanford University; Montana, Washington, Oregon, Idaho and Wyoming, Edward C. Elliott, chancellor of the University of Montana.

Becomes Secretary of the American Association of Engineers

Selected as secretary of the American Association of Engineers, C. E. Drayer, assistant valuation engineer of the Nickel Plate, will leave Cleveland in a few days to take up his new work in Chicago.

Mr. Drayer has been actively engaged in engineering society work of local and national character for the past eight years. After graduation from college in Cleveland, Ohio, he served on Western railroads until 1910, when he returned to Cleveland to become field engineer for the Nickel Plate Railroad in grade elimination work. He immediately joined the Cleveland Engineering Society and began to put into practice, as opportunity offered, ideas of advancing the engineer in public esteem and of engineers training themselves to be leaders in service to the community. After two years of work in the local society in Cleveland he began to carry the same message to other societies and in time addressed most of the engineering organizations

C. E. DRAYER

east of the Mississippi. In 1915 he became associated with Dr. F. H. Newell in forming the Committee on Engineering Coöperation, of which he is secretary. He organized and is secretary of the Ohio Association of Technical Societies.

He was joint editor of "Engineering as a Career," a series of articles of advice to young men. Several years ago he became editorial correspondent at Cleveland for *Engineering News*. Since the consolidation of *Engineering News* and *Engineering Record* he has continued in that capacity for *Engineering News-Record* up to Aug. 1. Most of his articles on engineering society organization have appeared in the two journals named. Mr. Drayer served the Cleveland Engineering Society as its secretary for two years, and was a member of its executive board when elected secretary of the American Association of Engineers. He formulated the plan of combined membership of the American Association of Engineers and Cleveland Engineering Society outlined by him in *Engineering New-Record* of Aug. 1, 1918, p. 217.

Mexican Engineers in Chicago Buy Irrigation Machinery

Officials of the Agricultural Department of the Mexican Government, most of them engineers, were in Chicago recently purchasing irrigation and farm machinery as a result of a survey of proposed agricultural development in the northern part of Mexico and conditions in the neighboring states to the north.

Amends Draft Questionnaire for Technical Schools

Includes New Clause Which Provides for the Exemption of Students and Professors

Under a recent ruling of the provost marshal general the draft questionnaire has been amended so as to provide a hitherto lacking blank whereby engineering students may claim exemption. The ruling further extends the class to teachers of engineering and instructors in military science in the schools. Section 151 of the selective service regulations has been revised as follows:

"Under such regulations as the Secretary of War may prescribe a registrant who is regularly enrolled in a school approved by the War Department Committee on Education and Special Training, and is pursuing full-time courses leading to a bachelor or higher degree in medicine, engineering, physics, chemistry or other technical subjects essential to the prosecution of the war, or who is an indispensable teacher in such courses, or who is engaged in the training of Army personnel may enlist in the Enlisted Reserve Corps, and thereafter, on presentation by the registrant to his local board of a certificate of enlistment, he shall be placed in Class V, Division D, on the ground that he is in the military service of the United States."

The provost marshal general further states that inasmuch as Division D of Class V includes "persons in the military or naval service of the United States" it is apparent that students who have enlisted according to the provisions of the paragraph cited above may make claim for deferred classification in Class V, Division D, as being in the military or naval service of the United States.

Safety Congress To Discuss Accident Prevention by Contractors

Accident prevention in construction operations will be the subject of one full day's deliberations at the National Safety Council Congress to be held in St. Louis, Mo., Sept. 16-20, inclusive. At this meeting steps will be taken to organize a permanent construction section of the council. The construction program, which will occupy the time of the congress during the morning and afternoon session of Sept. 18, will include the following papers: "Organizing for Safety—How To Secure the Coöperation of Superintendents, Foremen and Men"; "Safe Construction of Scaffolds and False Work"; "Effect of Accident Prevention on Insurance Rates"; "Accident Prevention in the Shipbuilding Program"; "Benefits of Accident Prevention in Contracting"; "Handling Material, by Machine and by Hand," and "How a Small Contractor Reduced Accidents." S. J. Williams, manager of the accident prevention division, National Safety Council, Chicago, is in charge of the program.

Free Disposal for St. Louis Garbage Delivered at Works

Only one formal bid for garbage disposal by reduction was received by the city of St. Louis, Mo., Aug. 6. The present contractor, the Indiana Reduction Co., offered to renew the contract expiring Sept. 1 at the present rate of 87c. a ton paid to it, the city to continue to deliver the garbage to the company at two loading stations within the city. As an alternative, the company offered to dispose of the garbage without charge, provided the city would buy its loading stations and river barges at a valuation of about $20,000 and deliver the garbage to the company's reduction works daily. The city declined this proposition, but offered to tow the garbage without charge from the loading stations to the reduction works, using the city harbor boat, at an estimated cost of 15c. a ton. This proposition was accepted by the company. The new contract will expire Mar. 1, 1920, but will be terminable by the company on 60 days' notice. The city will prohibit private collection by farmers. It is expected that the city will take immediate steps for the installation of a permanent municipal system. The second and informal bid, offering to dispose of garbage and street sweepings without cost to the city, was from two individuals said to represent the American Gas & By-Products Co. of Chicago. It substituted its own for the city's specifications and stipulated that the city must turn over to the bidders the Hirsh experimental plant described in *Engineering News-Record* of Sept. 20, 1917, p. 535, which is not in the possession of the city, and which the city officials assert has not fulfilled contract requirements.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Sept. 2, Denver, and Sept. 3, Colorado Springs, Col.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS; Pittsburgh; Sept. 9-13, Baltimore.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS; 304 East Walnut St., Bloomington, Ill.; Oct. 2-4, Buffalo, N. Y.

AMERICAN PUBLIC HEALTH ASSOCIATION; 126 Massachusetts Ave., Boston, Oct. 14-17, Boston.

The War Committee of the Technical Societies of Chicago held the first of a series of meetings, for the 6000 members of the 19 societies interested, at the Art Institute in Fullerton Hall on Aug. 1, at which more than 450 engineers attended. The meeting was addressed by S. J. Duncan-Clark, war analyst of the *Chicago Evening Post* on "Recent Developments on the War Front." W. L. Abbott, vice-chairman of the committee, explained the get-together spirit with which the societies in Chicago were working on war problems of the profession.

The Minnesota Joint Engineering Board called a meeting for Wednesday evening Aug. 7, at St. Paul, to meet Alfred D. Flinn, secretary of the Engineering Council. Mr. Flinn explained the work of the United Engineering Societies, Engineering Foundation and the Engineering Council, and asked for suggestions from the engineers of Minnesota and adjacent territory as to how these three organizations could serve them best. A representative of each of the societies present took part in the discussion following Mr. Flinn's address. The Engineers' Society of St. Paul acted as host.

The Engineers' Club of Columbus, Ohio, devoted an entire session July 26 to a committee report on "Flood Protection." E. A. Hitchcock, of the E. W. Clark & Co. Management Corporation, outlined the ten projects presented by Alvord & Burdick and Prof. C. W. Sherman discussed in detail the Summit level project. The annual outing of the club was held Aug. 10 at Glenmary Park.

The Engineers' Club of Northern Minnesota has elected W. J. Downing, chief engineer, Shenango Furnace Co., Chisholm, as its representative on the Minnesota Joint Engineering Board.

The Smoke Prevention Association will hold its next annual convention in Newark, N. J., Aug. 20-30. A tentative program has been arranged by Daniel J. Maloney, smoke inspector of Newark, vice-president of the association. The program will include papers on "Proper Hand Fire Practice in Relation to Firing Furnaces as Applied to Heating Plants," and "Boiler Room Efficiency." An entire day of the convention will be devoted to railroad matters, when papers will be read on the method of firing used by the Pennsylvania Railroad.

PERSONAL NOTES

J. W. BEARDSLEY, who was appointed last March as consulting engineer to the Ordnance Department at large, as mentioned in *Engineering News-Record* of Apr. 4, sailed from San Francisco for China July 31 to become assistant chief engineer of the survey of the Grand Canal of China from Tien Tsin 200 miles south. Mr. Beardsley was chief engineer of the Porto Rican Irrigation Service from 1910 to 1916, when he resigned to enter private practice as a consulting engineer. He was formerly employed by the J. G. White Engineering Corporation on investigations of irrigation projects, previous to which he was for seven years engaged in engineering work in the Philippine Islands as chief of the bureau of engineering and later as director of public works. He was graduated from Cornell University in 1891, and after service in Newton, Mass., and Chicago, he accepted a position with the Deep Waterways Commission in 1898. Two years later he entered the Corps of Engineers and in 1902 went to the Philippines. As consulting engineer for the Philippine Commission he investigated irrigation works in Java, Burma, India and Egypt.

EDWARD D. RICH, state sanitary engineer of Michigan, has received a commission in the sanitary corps of the National Army, and will be assigned to duty as chief instructor of sanitary engineers at Camp Greenleaf, Georgia. Captain Rich will succeed Chief Instructor Maj. William C. Hoad, formerly professor of sanitary engineering at the University of Michigan, who was commissioned as major in the sanitary corps of the National Army, at first attached to the office of General Gorgas in Washington, as previously mentioned in *Engineering News-Record*.

A. S. BALDWIN, chief engineer of the Illinois Central R.R., has been elected vice-president of the corporation. Mr. Baldwin, who was born at Winchester, Va., in 1861, entered railroad service in 1880 as rodman for what is now part of the Chesapeake & Ohio Ry. After a year he went with the Iron & Steel Works Association of Virginia, but in 1884 returned to railroad work and was for two years in the employ of the Baltimore & Ohio R.R. on the construction of its Philadelphia extension. He then went to the Chicago, Milwaukee & St. Paul Ry. as principal assistant engineer on the construction of its bridge across the Missouri River at Kansas City. From 1888 to 1901 he was with the Louisville & Nashville R.R. as assistant engineer, assistant to chief engineer and roadmaster, successively. In 1901 he began his service with the Illinois Central R.R. From 1901 to 1902 he was principal assistant engineer, from 1903 to 1904 engineer of construction and from 1905 to the present time chief engineer. Mr. Baldwin was president of the American Railway Engineering Association for the year 1916-17.

BENJAMIN B. FREUD and Harold A. Moore, Chicago, have been appointed captain and second lieutenant, respectively, in the Ordnance Reserve Corps.

RALPH BUDD, formerly chief engineer of the Great Northern Ry., has been elected chairman of the corporate executive committee of the Chicago, Burlington & Quincy R.R. After his graduation from Highland Park College of Engineering, Des Moines, Ia., in 1899, Mr. Budd entered railway service in the engineering department of

the Chicago Great Western, serving as draftsman, rodman, instrument man and assistant engineer, later becoming roadmaster and road superintendent of construction for the St. Louis division. Later he became division engineer. In 1906 Mr. Budd went to Colon, as chief engineer of the Panama R.R. In 1909 he became chief engineer of the Oregon Trunk Ry. and in 1910 chief engineer for the Spokane, Portland & Seattle Ry. Early in 1913 Mr. Budd was made assistant to the president of the Great Northern Ry., a few months later being appointed chief engineer.

A. J. WITCHEL has been appointed chief engineer of the Spokane & Inland Empire R.R. and the United Rys. Co. with headquarters at Portland, Ore. Mr. Witchel has been connected with the North Bank (Columbia River) System since its organization. The properties which he will now supervise were not taken over by the Government when the Spokane, Portland & Seattle, Oregon Electric & Oregon Trunk Line were federalized. A. E. Lufer, Federal chief engineer of the Spokane, Portland & Seattle lines, will relinquish supervision of the Spokane & Inland Empire and United Rys. lines.

CHARLES A. SMEATON, Chicago, has been appointed first lieutenant in the Engineer Officers' Reserve Corps.

CHARLES H. SWIGART, for several years connected with the United States Reclamation Service in the vicinity of North Yakima, Wash., and formerly project manager of the Yakima project, has been transferred as supervising engineer of the Columbia River irrigation district, including the irrigation project on the Columbia near Kennewick.

W. R. DRURY, instructor in sanitary engineering, University of Michigan, and assistant in the firm of Hoad & Decker, consulting engineers, Ann Arbor, Mich., has become associated with the Merchant Shipbuilding Corporation, Bristol, Pa. Since his graduation from the University of Michigan in 1913, Mr. Drury has been assistant city engineer of Ann Arbor.

THOMAS S. GRIFFIN, Brooklyn, N. Y., has been commissioned as captain in the Ordnance Reserve Corps, and assigned to duty with the civil engineering unit of the construction section, Supply Division.

J. H. MOORE has resigned as city manager of Sault Ste. Marie, Mich. Wilder Rich, city engineer, has become acting city manager.

CHARLES FITZSIMMONS, assistant to the chief engineer of highways for the southwestern district of Pennsylvania, has been named chief engineer, succeeding S. W. Jackson, who has been appointed superintendent of construction for the entire state west of the Susquehanna River, as noted elsewhere in this issue.

H. E. JORDAN, superintendent of the filtration plant of the Indianapolis Water Co., has been commissioned as captain in the maintenance and repair branch of the Quartermaster Corps and will be assigned to duty in connection with cantonment water supply.

R. J. F. CALKINS, city engineer, Everett, Wash., has resigned to take up work with the bureau of water resources of the United States Geological Survey, with headquarters at Tacoma. Mr. Calkins has been connected with the city engineer's office for ten years, becoming city engineer a few months ago.

TERRELL CROFT, consulting engineer and author, St. Louis, has been called to Washington, to assume charge of the work of standardizing electrical instruction for enlisted men. Mr. Croft's work will be under the educational committee of the War Department. He had been an instructor at Washington University, St. Louis

C. P. TOMLINSON, Hartford, Conn., has been appointed consulting engineer for the Southern Minerals Corporation, Boston, of which he is also a director. Mr. Tomlinson was graduated from the Sheffield Scientific School, Yale, 1907, and has been associated with Stone & Webster. Since 1914 he has been identified with the Ernest E. Smith interests.

A. W. HORWEGE, formerly city engineer of Petaluma, Cal., has been appointed assistant engineer by the United States Shipping Board and has been assigned to the concrete shipyard on Government Island at Oakland, Cal.

C. A. STRAND has resigned as city engineer of Eureka, Cal., to join the engineering staff of the Trojan Powder Company.

A. A. MATTHEWS, chief engineer of the St. Louis Southwestern Ry., has been appointed assistant chief engineer for all lines under the jurisdiction of J. L. Lancaster, Federal manager; E. S. Pennbaker has been appointed assistant to the chief engineer; R. L. Holmes, assistant engineer of the Texas & Pacific Ry., has been appointed engineer of water supply; W. D. Williams has been made bridge engineer—all with headquarters at Dallas, Tex. F. A. Mote and F. N. Baldwin have been made assistant engineers at Marshall, Texas, and New Orleans, respectively.

WILLIAM EATCHEL, for five years superintendent of properties of Multnomah County, Portland, Ore., has been appointed to succeed John B. Yeon, county roadmaster, who recently resigned to engage in spruce production work for the Government. Mr. Yeon will continue to serve as superintendent of the Columbia River Highway.

L. E. WEATHERWAX, secretary of the Seattle Master Builders' Association, and junior member of Hendrickson & Co., contractors, has enlisted in the Engineer Corps.

LEWIS P. SCOTT, assistant engineer, Illinois State Highway Department, in the Aurora office, has been commissioned first lieutenant in the Engineer Officers' Reserve Corps.

S. J. WILLIAMS, JR., principal assistant engineer of the Wheeling & Lake Erie Ry., has resigned.

S. W. JACKSON, chief engineer of highways for the southwestern district of Pennsylvania, has been appointed superintendent of construction for the entire state west of the Susquehanna River, with headquarters at Pittsburgh.

E. R. LEWIS, assistant to the general manager of the Duluth, South Shore & Atlantic Ry., has been appointed chief engineer.

PAUL E. GREEN, of the firm of Man, Green & Co., civil and sanitary engineers, Chicago, has entered the service of the bureau of industrial housing and transportation, Department of Labor, of which John W. Alvord is chief engineer.

RALPH R. BENEDICT, acting executive officer of the Board of Park Commissioners, Kansas City, Mo., has entered the service of the estimates and requirements section of the Ordnance Department.

F. L. NICHOLSON, chief engineer of the Norfolk Southern R.R., has been appointed consulting engineer of the Virginian Railway.

J. W. FOX, valuation engineer of the Central of Georgia Ry., has been appointed chief engineer for the company.

O. L. ELTINGE, assistant engineer, Sanitary District of Chicago, has been commissioned as first lieutenant in the Engineer Officers' Reserve Corps. Lieutenant Eltinge was previously chief draftsman in the sewer division of the City Engineering Department of Kansas City, Mo.

OBITUARY

W. H. NEWMAN, formerly president of the New York Central & Hudson River R.R., the Lake Shore & Michigan Southern Ry. and other New York Central lines, died Aug. 10 in New York City.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

President Warns Country of Extreme Fuel Crisis

Threatened Shortage Twenty Per Cent Greater Than Last Winter and Production Decreasing

President Wilson, by proclamation, has warned the country of a threatened coal shortage which may be 20% greater than last winter. Decreased production on account of miners avoiding deferred classification, resulting in the depletion of their ranks in the collieries, is adding to the danger. The President in his proclamation urges all miners, as a patriotic duty, to accept deferred classification and stay on the job, saying that the crisis demands the best work during a full number of work hours from "the highest official to the youngest boy."

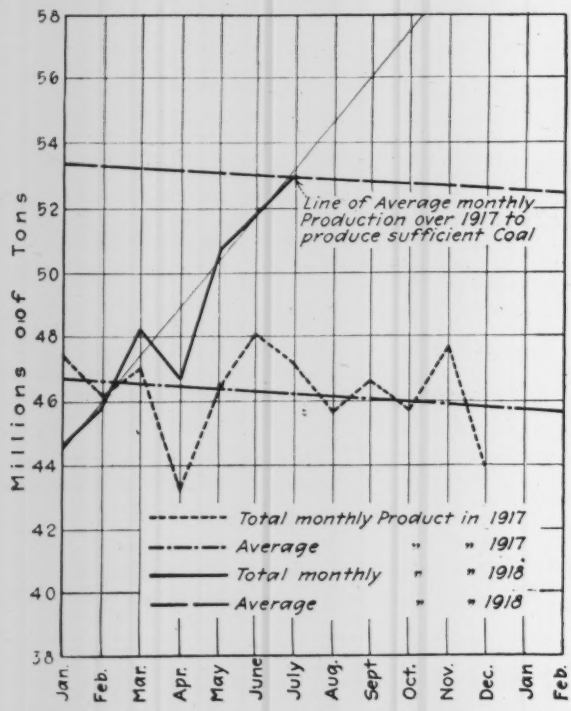
"And it is the patriotic duty of their friends and neighbors to hold them in high regard for doing so," he adds.

In *Engineering News-Record*, of July 18, p. 155, it was pointed out that the coal production, as indicated in the diagram that accompanied that article and which, with July production added, is shown herewith, must be such that the heavy line indicating the total monthly production of 1918 must follow the light line, to meet the coal shortage. It was stated at that time that the production curve was already flattening, but in the second and third week of July the rate was such as to indicate a rapid rise in the line instead of a flattening. The rate for the entire month, however, declined and this is the direct cause of the President's proclamation.

Recent bulletins from the Fuel Administration indicate that the production is running approximately 15,000,000 to 20,000,000 tons behind the schedule, so that it will be necessary to increase the output during August and September to exceed 14,000,000 tons per week or more than 60,000,000 tons per month, instead of the 53,000,000 tons shown for July.

Against this deficiency in production the demand for coal is growing so rapidly that all the estimates made at the beginning of the year are being broken down. Applications for additional allotments are coming from plants newly organized by the War Industries Board, unknown to its fuel administration at the beginning of the year; plants on the preferred list making large increases in their capacity; new shipyards that are being built in numbers far beyond expectation; increased bunkerings, and the Navy. The demand from this last item increased almost 100% in July.

The source of supply for this enormously increased demand lies within a very limited area, falling heaviest on the coal fields of the New River and Pocahontas Counties of West Virginia, and in Pennsylvania, Maryland and Kentucky. Though producing unprecedented quantities of coal, they lie in districts where transportation service is most difficult. The Fuel Administration, therefore, faces the difficulty of meeting the demand from this restricted area where car shortage is the largest factor, labor shortage coming next and mine disability a close third. Operators in portions of the New River and Pocahontas districts of West Virginia are the only ones reporting 100% car supply.



RATE OF SOFT COAL PRODUCTION BELOW REQUIREMENTS

Robert F. Hall Heads Lime Association as Manager

With Headquarters in Washington He Will Direct Association of Lime Producers Lately Organized

Robert F. Hall, well known in the portland cement industry, has been appointed secretary and general manager of the Lime Association. He will have his office in Washington and will manage the affairs of the Association of Lime Manufacturers of the United States, formed after consultation with and at the recommendation of the War Industries Board.

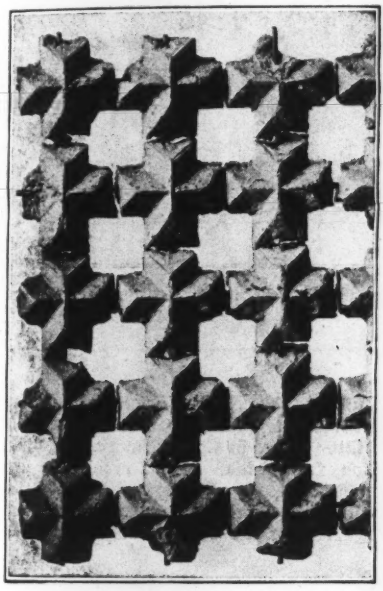
ROBERT F. HALL

Mr. Hall has been a resident of Chicago for 23 years and is a graduate of the University of Michigan, with the degrees of B.A. and LL.B. For a number of years he practiced law in the office of A. W. Green, who was president of the National Biscuit Co. Mr. Hall was associated with Mr. Green in the National Biscuit Co. and for 10 years occupied positions of trust and responsibility with that company. In 1909 he joined the forces of the Universal Portland Cement Co., and at various times held the positions of division sales manager and publicity manager. He resigned from the Universal Portland Cement Co. in April, 1916, to accept the responsibilities of the road promotion work of the Portland Cement Association, in which he remained until Aug. 1 of this year.

These connections with the cement industry brought Mr. Hall in touch with and enabled him to establish friendly relations with practically all of the cement manufacturers of the country. The last work with which he was connected in the cement industry was that of the building of concrete ships and the present advanced stage of that activity is attributed largely to his efforts.

Wire Lath Fireproofed by Baking on Small Terra Cotta Blocks

A novel fireproof lathing, consisting of a rectangular mesh of light wires with a terra-cotta covering baked on, has been placed upon the market and is finding extensive application in New York City. The accompanying cut shows a small section of the lath. The cross-shaped terra-cotta tablets which are baked onto the wires at their junction are not continuous, so that the lath can be put up in rolls for shipment, the wires bending at the junctions of the terra-cotta tablets. The terra-cotta, however, does stiffen the wire very much, and makes it easy to form a flat surface for plastering. The porous terra cotta forms a bond with mortar, obviating the necessity for forcing the mortar through, to form a key at the back; another advantage



FIREPROOF WIRE LATH

is that no furring strips are required. The stiffness of the lath is such that in some office buildings in New York City it was stretched tight from ceiling to floor and plastering was applied directly to both sides, forming a 2-in. solid partition, and the construction was approved by the New York Building Department after fire tests. Another use of this material is to form a plastering surface on which a finishing coat may be applied to concrete walls.

By placing the wire lath against the inside of the forms before the concrete is poured, the lath is left embedded in and firmly attached to the concrete, and furnishes a rough terra-cotta surface of sufficient bond for plastering. This lath has been used extensively in this way in the stations of the new subways in New York City. It is also being used in the construction of the new Pennsylvania Hotel.

Another use to which this material has been put is the fireproofing of large electric cables. A layer of the lath is wrapped around the cable, wired in place, and plastered. This lath is manufactured and sold by the Composite Metal Lath Co., 110 West 40th St., New York City.

Norway Strives To Be First Over Ocean with Concrete Ship

Norway is competing with the United States for the honor of building the first trans-Atlantic concrete vessel. At present the United States leads the world in the building of concrete ships, both in number and in size, but Nick Fougner, president of the Fougner Concrete Shipbuilding Co., of Norway, hopes to be the first to cross the Atlantic Ocean in one of his own concrete ships.

The shipyard of which Mr. Fougner is the head was described in *Engineering News-Record* of Dec. 13, 1917, p. 1088, and the accompanying illustration of the ship "Stier," a 1000-ton concrete vessel, shows a recent product of this shipyard. The vessel is 145 ft. over all, 27½ ft. beam, 15 ft. 9 in. molded depth, and is equipped with an internal combustion engine of 320 hp. It has four water-tight transverse bulkheads of concrete which make the ship practicably unsinkable when carrying a reasonable amount of cargo, the builders believe.

It is expected that the Norwegian builders will adopt the new protective coating which when applied to concrete makes a concrete ship equal in durability to a steel vessel. This discovery is the result of the research work recently done by the engineers of the Emergency Fleet Corporation of the United States.

This company has under contract 12 additional seagoing concrete motor ships, varying in size from 200 to 3000 tons dead weight, and it has already launched a number of craft of various types.

Summer Meeting of Industrial Traffic League

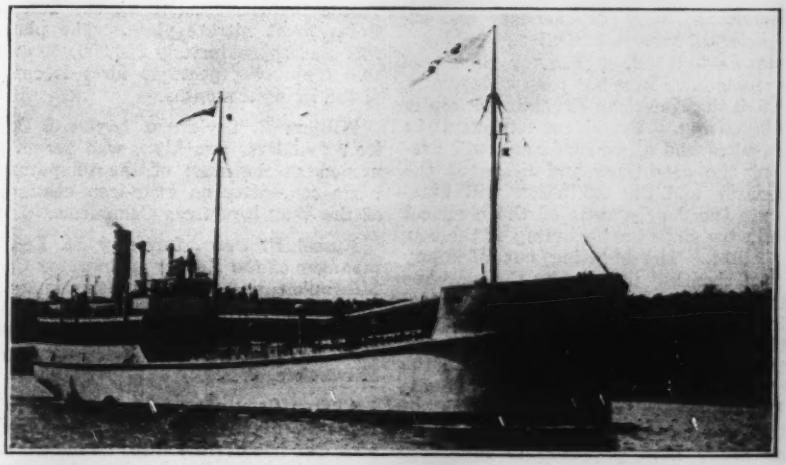
A summer meeting of the National Industrial Traffic League will be held at the Hotel Statler, Cleveland, Ohio, Thursday and Friday, Aug. 29 and 30. This is a postponed date from that given in *Engineering News-Record* of July 25, p. 203. The program of subjects, as announced by the league, will be of considerable importance, and will be published and distributed shortly. Every member is urged to arrange his appointments so as to be able to attend this meeting, and the league invites traffic representatives of organizations or individual concerns not members of the league. The secretary requests a list of such names and of prospective members to be sent to E. F. Lacey, assistant secretary, 413 Tacoma Bldg., Chicago.

Women in the Drafting Room

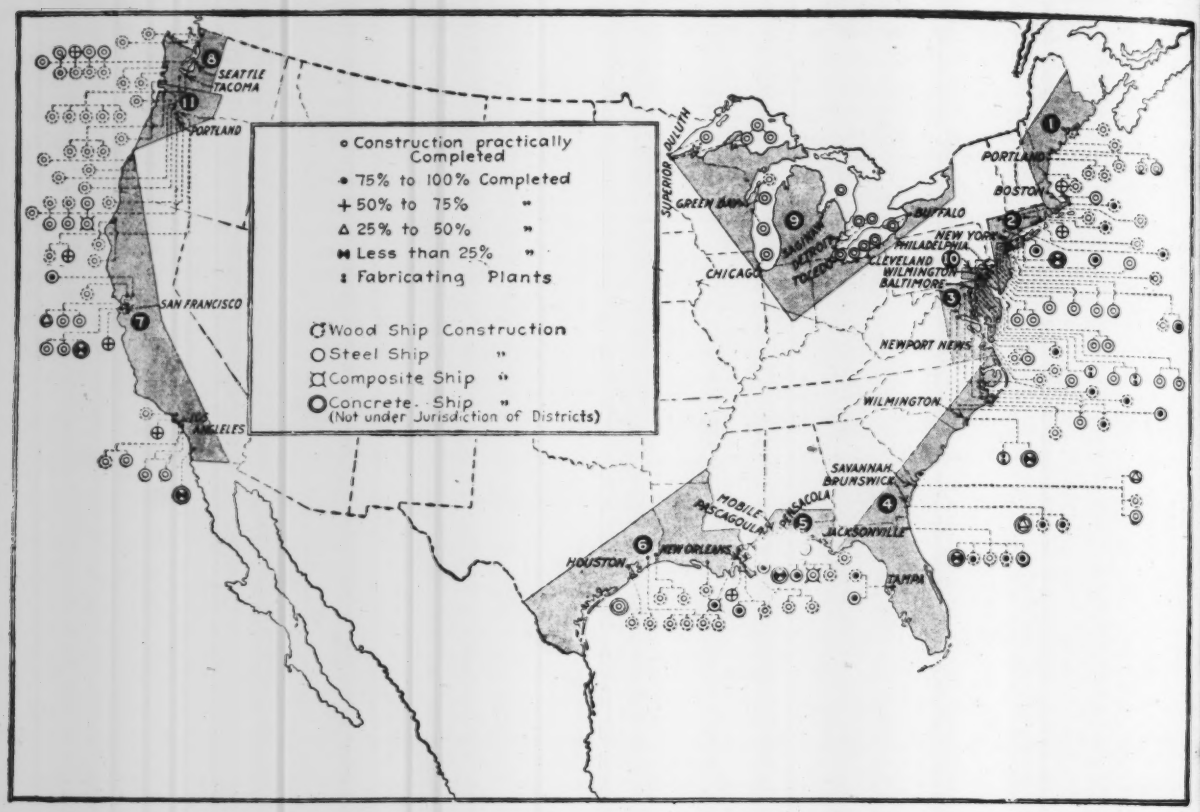
Although the employment of women in the drafting room is not new, it has not, until recently, received much attention. Now, however, the men being called to the colors from this occupation are being replaced by women in increasing numbers. In a recent issue of *Iron Age*, an article on the training of women for the drafting room told the methods employed in the engineering department of the Norton Grinding Co. The system and the results obtained are described by Howard W. Dunbar and W. E. Freeland.

The authors state that the work has not been in progress long enough to determine what will be the measure of success, but so far the adaptability for this work shown by the women is particularly promising.

The Young Women's Christian Association, desiring to coöperate with the Government and having experience in meeting the needs of young women, has established a Bureau of Coöperation with Employers for Industrial Managers, and is prepared to recommend to manufacturers women qualified for positions as employment managers.



TYPE OF NORWEGIAN CONCRETE SHIP EXPECTED TO CROSS ATLANTIC



SHIPYARD CONSTRUCTION FOR COUNTRY SHOWS RAPID STRIDES—MUCH WORK STILL UNDER WAY IN SOUTHEAST

Chemical Industries Will Hold National Exposition

The Fourth National Exposition of Chemical Industries will be held in Grand Central Palace, New York City, Sept. 23-28. It is announced that the advisory committee is working to make every department of the exposition a success.

Exhibits are expected from all parts of this country and Canada. The materials displayed will be of interest and benefit not only to chemists and financiers, but to technical and business men as well. A section for glass and ceramic industries has been added, with which the American Ceramic Society is coöperating. Prominent speakers in chemical and allied industries will present the conditions and needs of the country and the exhibition will illustrate the development of the chemical industry since the beginning of the war in 1914. The shutting out of many vital chemical imports by the war has tended to develop the domestic chemical industries to unprecedented proportions. This exhibition is an outcome of that expansion and will illustrate the changes made in the industry of the United States from the beginning of the war as well as the development of many new processes to meet the emergency demand.

Business Notes

G. M. Rockwell, recently with the Republic Motor Truck Co., has been made district manager and special representative for the Acme Motor Truck Co., Cadillac, Mich.

The Air Nitrates Co. announces the selection of a site east of the City of Toledo for the erection of the Toledo Government nitrate plant. The plant will cost approximately $20,000,000 and the company expects to have it completed in eight months.

William E. Taylor, of Taylor & Co., iron founders, Brooklyn, was recently named as chairman of the temporary trade committee on gray-iron castings of the War Resources Committee.

Russel E. Dean, formerly St. Louis manager of the Kerner Incinerator Co., Milwaukee, and recently sales manager of the Murphy Door Bed Co., St. Louis, Mo., has joined the Rex concrete mixer sales force of the Chain Belt Company, Milwaukee, Wis.

Clifton Reeves, president and general manager of the Reeves-Cubberley Engine Co., has been selected as industrial manager of the Curtiss Aëroplane Co. Buffalo, N. Y. For several years Mr. Reeves was the manager of the United States Board of Conciliation and Mediation, from which he has received a six months' leave of absence. Mr. Reeves will have complete control and management of the Curtiss factory.

Trade Publications

The Concrete Engineering Co., Omaha, Neb., has issued a handbook of fire-resisting construction illustrating various methods of construction followed by that company, and designing data. The book contains cuts of various structures erected by this company.

"The Martin Ditcher Grader and Terracer" is the title of a 28-p. catalog received from the Owensboro Ditcher & Grader Co., Inc., Owensboro, Ky. It illustrates the variety of uses for which this machine will be placed.

The Steel City Electric Co., Pittsburgh, Penn., has issued Catalog No. 33, dated May, 1918. It is a paper-bound book of more than 100 p., covering the goods handled and other useful data.